

Gypsum and Anhydrite Resources in Nova Scotia

G.C. Adams

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**Department of
Natural Resources**

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GYPSUM AND ANHYDRITE RESOURCES IN NOVA SCOTIA

by

G. C. Adams

ABSTRACT

Gypsum and anhydrite have been produced for exportation in Nova Scotia for over 200 years. A total of 6.3 Mt of gypsum and anhydrite were produced by six companies from eight sites in the Province in 1987. Nova Scotia is the world's most productive gypsum mining area and yet little information was available, at the outset of this project, regarding the Province's gypsum and anhydrite resources.

Between 1985 and 1989 field studies and literature research accumulated data on 186 surface and subsurface gypsum and anhydrite occurrence areas in Carboniferous rocks within the Province. These areas vary from occurrences of strictly geological interest to those having good potential for future resource development, as well as past and present producing deposits. The data are presented by occurrence listed alphabetically within each county of the Province.

Forty areas were deemed worthy of additional investigation. These are highlighted on the map in the back pocket. Ten are felt to meet the best geological, geographical and social conditions to allow possible resource development. None of these areas have proven reserves and would require drilling programs to substantiate the evidence presented in this report.

Gypsum is often considered to be a ubiquitous commodity in Nova Scotia. Economically viable deposits of gypsum and anhydrite cannot be placed in that category. Additional resources are present in the Province, however much effort will be required to allow them to be classified as reserves.

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CHAPTER 1. INTRODUCTION

Nova Scotia is strategically located in southeastern Canada on the Atlantic Ocean with easy access to the Great Circle Route. Numerous deep water harbours provide shipping opportunities to markets in the Eastern Seaboard of the United States, the Caribbean, Europe, Africa and via the Panama Canal to Pacific Rim destinations. Gypsum has been produced in the Province and exported to a variety of markets, predominantly in North America, for over 200 years.

Nationwide, in 1988 the value of metals production was approximately six times the value of nonmetals production (Vagt, 1989). Nova Scotia, on the other hand, produced \$388.6 million worth of minerals in 1986 (with production primarily in nonmetallic minerals, especially coal), 25.4% of which was industrial minerals and only 5.4% metals (Nova Scotia Department of Mines and Energy, 1987). This trend is a long standing one in the Province as is the fact that the production of gypsum and anhydrite have greatly contributed to the economy of certain areas of the Province.

According to Statistics Canada, 6.27 Mt of gypsum and anhydrite were produced in Nova Scotia in 1987 which is 69% of Canada's total production. That year gypsum producers directly employed 485 people and spent \$26.8 million in the Province on wages, materials, supplies, fuels and electricity. They also employed three dedicated unit trains, many highway trucks and company owned and chartered vessels to get their products to market. Statistical information published by Roskill Information Services Ltd. (1987) shows that Nova Scotia is the most productive gypsum mining area in the world.

Gypsum or hydrous calcium sulphate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) and anhydrite (CaSO_4) are ubiquitous minerals which are found in virtually every country in the world. Roskill Information Services Ltd. (1987) listed 38 nations in which gypsum, anhydrite or both were produced and reported in 1985, however Davis (1988) listed 77 producing nations including those producing byproduct gypsum. Natural supplies of gypsum and anhydrite worldwide are described by many authors as inexhaustible and ever increasing amounts of byproduct gypsum now exceeds current demand.

Gypsum usage goes back as far as recorded history having been carved by the early Chinese, Assyrians and Greeks. According to Schroeder (1970) it was used as a mortar in the Egyptian pyramids in 3000 B.C. and Pressler (1985) indicated that the burning or calcining of gypsum was described by the early Greeks. The development of gypsum plasters is difficult to trace; however, by

the late 1800s, a commercial process had been developed to slow the setting time thereby allowing widespread use of finishing plasters. In 1918 a development occurred in the United States which would later revolutionize the North American construction industry, prefabricated wallboard. Ten years later large scale production was achieved and gypsum wallboard was on its way to becoming the major end use of gypsum processed in North America (Schroeder, 1970; Pressler, 1985). Today this is a multibillion dollar industry.

Worldwide gypsum is used in prefabricated board products, building blocks, plasters, as a set retarder for cement, in agriculture to condition soil or as a fertilizer and as a filler in a multitude of products. Roskill Information Services Ltd. (1987) reported world production in 1985 at 80.9 Mt. The United States is the world's largest producer at 13.4 Mt in 1985 or 16.5% of the gypsum produced in the world. It is also the largest importer, buying 9.0 Mt from sources outside the United States in 1985. Canada ranks second at 8.4 Mt (10.4%) produced in 1985 and is the largest exporter of crude gypsum and gypsum products, most of which goes to the United States. The Province of Nova Scotia dominates gypsum production in Canada averaging 70% of the crude gypsum mined in the nation each year. Virtually all of this material is exported to foreign and domestic destinations.

Widespread, large, readily extractable reserves of gypsum around the world result in the fact that gypsum and anhydrite are low value, high bulk commodities that are subject to minor fluctuations in both local and global economies. All major gypsum fabrication companies are vertically integrated enabling them to ensure long term stability to survive the cyclical nature of an industry that is so intimately associated with the construction industry. Large scale, low cost production facilities at both the mining and fabrication stages are necessary to ensure long term survival. Gypsum does trade on the world market as is seen by the increase in imports of Spanish gypsum by the United States during the 1980s, but such arrangements are highly susceptible to fluctuations in currency exchange rates and the availability of low cost shipping.

Generally, most sources believe that natural supplies of gypsum and anhydrite are adequate to supply the world's needs for the foreseeable future. Recent technological and environmental developments have increased the acceptability of using byproduct gypsum in the marketplace. Gypsum and anhydrite are produced as byproducts of any chemical process which requires the

neutralizing of waste acids using calcium carbonate, as well as those techniques used to remove sulphur from the flue gases of coal fired engines (see Byproduct Gypsum). At current levels the generation of byproduct gypsum is greater than total crude gypsum production and greater than total world demand. Although currently small, consumption of byproduct gypsum is slowly increasing and will gradually make inroads into the crude gypsum markets unless technological advances change present trends.

Demand projections for gypsum for various uses have been made (Pressler, 1985). It estimates an overall growth rate of 2.6% domestically and a world wide rate of 2.4% to the year 2000. These figures reflect total demand and cannot distinguish between crude and byproduct gypsum, an unknown which could possibly affect crude gypsum dramatically in the near future.

PREVIOUS WORK

Due to the extensive history of gypsum and anhydrite production in the Province, these commodities have long been the subject of study by those interested in developing the industry. References to gypsum abundance and production for export appear as early as 1828 (Jackson and Alger, 1828a, b), 1829 (Haliburton, 1829) and 1836 (Gesner, 1836). Dawson (1855) briefly mentioned gypsum and anhydrite and How (1869) went into somewhat more detail on the production of gypsum and anhydrite in the Province and included some statistics on production and exports.

Gilpin (1881) wrote a brief account of gypsum in Nova Scotia and Jennison (1911) included extensive observations from this Province in his report to the Canada Department of Mines. This major work included descriptions and analyses from all of the gypsum producing areas of the day, as well as technical data on all of the latest plaster manufacturing technology. Cole (1913) gave a brief description of most of the gypsum quarries in the Province in addition to including Jennison's (1911) report as an appendix in his publication.

More recent studies on gypsum in the Province include Cole's (1951) report on the competitive advantages of gypsum mining operations in Nova Scotia and possibilities for secondary processing, Goodman (1952) who described the geology and origin of gypsum and anhydrite deposits and Wright (1974) who reviewed a limited number of gypsum occurrences. With the exception of Goodman (1952) and Bell (1929), very little attention has been given to the geology and genesis of gypsum and anhydrite deposits in the Province.

SCOPE AND PURPOSE OF THIS INVESTIGATION

The Gypsum/Anhydrite Project was initiated in June 1985 through the Canada-Nova Scotia Mineral Development Agreement to develop an inventory of gypsum and anhydrite resources in the Province. Three objectives were established for the project. The first was to develop a comprehensive inventory of the Province's gypsum and anhydrite resources; the second was to establish a working rapport between the Nova Scotia Department of Mines and Energy (NSDME) and the Province's current producers; and the third was to initiate and encourage development of more diverse ways to utilize Nova Scotia's gypsum and anhydrite resources.

Preliminary research included computer searches using the Department's computerized drillhole database as well as the Geological Survey of Canada's (GSC) coordinated GEOSCAN bibliographic geoscience literature database. At that time the drillhole database included only drillholes from assessment reports and did not contain government drillholes. Even so, in excess of 1400 drillholes were selected by the search as containing gypsum, anhydrite or both. GEOSCAN provided a list of over 700 entries from maps, theses, assessment reports, NSDME annual reports and miscellaneous reports which contained references to gypsum, anhydrite or both.

Using the National Topographic System (NTS) all the data were divided into blocks falling within the confines of 1:50 000 topographic maps. Once this was accomplished, the task of tracking down and obtaining the materials selected by the computer searches began. By early 1986 all of this information was gathered and collated by map sheet in preparation for the field investigations of all reported surficial gypsum/anhydrite occurrences.

The most comprehensive observations of surface occurrences of gypsum and anhydrite available on a Province-wide basis were contained in Fletcher and Faribault's late 1800s series of geological maps. Occurrences were transferred from these one mile to one inch (1:63 360) scale maps to 1:50 000 topographic maps. This information, typical of these old series maps, later proved to be remarkably accurate and invaluable in the field.

Beginning in 1986, three field seasons were required to carry out site visits on all known or reported occurrences in the Province. All exposures found in the field were measured and sampled and later these data were combined with literature research information to produce the final occurrence writeups which appear in this

text. Field samples are shown on the occurrence location maps which appear in the text. Their identifying numbers (e.g. R-201) correspond to analytical data located in Appendix 3.

GENERAL GEOLOGY OF GYPSUM AND ANHYDRITE IN NOVA SCOTIA

All economically significant occurrences of gypsum and anhydrite found in Nova Scotia lie within the Early Carboniferous Windsor Group. In Nova Scotia the Windsor Group consists of interstratified marine and nonmarine sedimentary rocks which were deposited in a large complex intracontinental basin. The basin system developed during the late Paleozoic in the northeastern portion of the Appalachians following the Acadian Orogeny. The basin system was referred to as the Fundy Basin by Bell (1958), but currently the erosional remnant is referred to regionally as the Maritimes Basin (Roliff, 1962). The Windsor Group is usually underlain by the Horton Group, a thick sequence of continental clastic sedimentary rocks which were deposited in the same basin system over older deformed metamorphic and igneous rocks. Continental clastics of the Canso (Mabou) Group overlie the Windsor Group although locally younger Carboniferous strata of the Riversdale, Cumberland and Pictou Groups may overlie it.

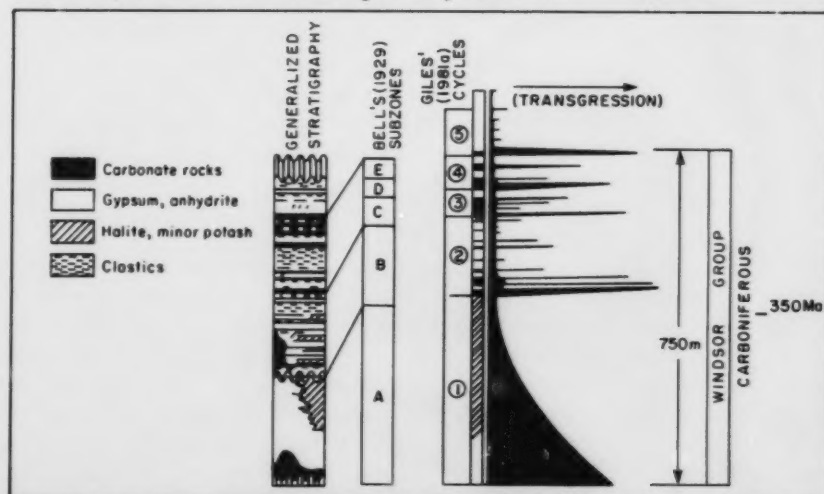
Bell (1929) studied the Windsor Group in the Windsor, Hants County, area and subdivided it on the basis of fauna into two major zones (Upper and Lower) consisting of five subzones labelled A through E (stratigraphic base to top). Recent work by Giles (1981a) subdivided the Windsor Group on the basis of major transgressive-regressive cycles (Fig. 1-1) (Giles, 1981a). The five cycles have been defined primarily on lithostratigraphy and coincide closely with the biostratigraphy defined by Bell (1929). The major cycles have been applied to the Windsor Group throughout the Province. The uppermost of these cycles (Cycle 5) extends into the overlying Canso (Mabou) Group.

Gypsum and anhydrite can be found in all five major cycles in the Windsor Group as well as extending in the basal part of the Canso (Mabou) Group. Economically significant sections of gypsum and anhydrite are restricted to the two lowermost Cycles, 1 and 2 (Giles, 1981a; Boehner, 1986). Major Cycle 1 comprises 40-90% CaSO_4 , Major Cycle 2 up to 75% CaSO_4 , and Major Cycles 3 to 5 are typically <20% CaSO_4 (Boehner, personal communication, 1990).

Cycle 1 is roughly correlative with A Subzone (Bell, 1929) and represents a rapid marine transgression into the Maritimes Basin system during the Early Carboniferous. The initial transgression was followed by basin restriction and evaporite deposition in a thick cover 400 m progressive sequence. The earliest marine deposits were thin laminated carbonates within the basins and thicker bank facies on paleotopographic highs (Giles, 1981a). With increasing salinity the marine carbonates were succeeded by the thick massive to moderately stratified basal sulphate up to +300 m thick. The anhydrite is succeeded laterally and vertically by thick halite and locally potash salts. The end of Cycle 1 is represented by karstification, infilling and minor deposition of siliclastics under subaerial conditions (Giles, 1981a).

Cycle 2, in contrast, comprises a number of thinner (typically <30 m) transgressive-regressive cycles of carbonates, evaporites and clastics. Laterally the evaporite component has a wide range (5-85%). Major Cycle 2 typically is 150-200 m thick, but locally may exceed 500 m becoming increasingly clastic-rich towards the top. Economically significant calcium sulphate horizons in Cycle 2 are confined to its lower portion. These horizons vary in thickness due to deformation, but are generally <20 m (Lewis and Holleman, 1983).

Similar to Cycle 2 major Cycles 3, 4 and 5 also comprise numerous small transgressive-regressive cycles (Giles, 1981a).



modified after Bell, 1929; Giles, 1981a

Figure 1-1. Major cycles and subzones of the Windsor Group.

The proportion of evaporite contained in these upper cycles is less than in Cycles 1 and 2 (30% maximum) and generally of little economic interest. The uppermost marine carbonate found in Cycle 5 defines the top of the Windsor Group even though thin calcium sulphate and halite beds were deposited in the overlying Canso (Mabou) Group during the final stages of marine regression in the Fundy Basin system (Giles, 1981a).

Boehner (1986) suggested that the major change in the depositional sequence between Cycle 1 and Cycles 2-5 is the result of basin infilling by the evaporites deposited during Cycle 1. Deposition went from deep water basins with gradually increasing salinity and decreasing size as well as significant inherited paleotopography during Cycle 1 to a shallow water setting, susceptible with subdued (infilled) topography to widespread transgressive/regressive minor cycles during Cycles 2-5.

GYPSUM AND ANHYDRITE DEPOSIT TYPES

Although evaporites have been the subject of extensive studies elsewhere in the world, the Windsor Group evaporites in Nova Scotia have not been studied in similar detail. Bell (1929) proposed that the thick basal sulphates were deposited in sea lagoons connected to a sea by a restricted channel. Goodman (1952) believed that the Province's calcium sulphate deposits were originally laid down as anhydrite in lagoons "... rhythmically replenished with marine waters" Schenk (1969) concluded the evaporites of the Windsor Group represented diagenetic deposition in a coastal sabkha-salina environment (supratidal CaSO_4) and halite in a landward salt flat playa environment.

More recent work by Evans (1972) on the evaporites found in the salt mine at Pugwash, Cumberland County, has examined in detail the deposition and diagenesis of calcium sulphates in the mine section. He concluded that the calcium sulphate horizons in the lower part of the Windsor (Cycle 1) were deposited in a restricted sea under water of <150 m depth as gypsum crystals forming within carbonate sedimentary rock. Shortly after deposition the gypsum was replaced by anhydrite. Evans (1972) also suggested, as does Boehner (1986), that the thinner, interbedded calcium sulphate horizons found in Cycles 2-5 of the Windsor Group may have been produced in a different environment, probably the sabkha environment described by Schenk (1969) rather than entirely in restricted sea lagoons. Boehner (1986) concluded that both sabkha displacive nodular evaporite deposition and shallow subaqueous (saline pan) evaporite deposition coexisted during Major Cycles 2-5.

Two different depositional environments and lithological associations for Cycle 1 and Cycle 2 calcium sulphate deposits have led to modern gypsum and anhydrite deposits with distinctly different character. Complex structural deformation (tectonic and solution collapse) of those original deposits has greatly increased the complexity of modern deposits and occurrences. This in turn makes the delineation of economically viable deposits more difficult. Boehner (in press) suggests that the more ductile nature of the evaporite dominated Windsor Group has amplified the effects of tectonism on these strata. Intensity of deformation varies within the Group, as well as within basins depending on basin depth, abundance of salt and tectonic-sediment setting. Boehner (in press) proposes that three mechanisms produced much of the evaporite tectonism observed in the Carboniferous basins "... (1) decollement: gravity slides and thrusts, (2) compressive-transpressive, and (3) diapiric, tectonic and density contrast driven ..."

The differing depositional environments and resulting lithology in combination with the varied degrees of deformation (tectonic setting) have yielded distinctly different types of gypsum deposits in Nova Scotia. Lewis and Holleman (1983) made the first attempt to stratigraphically locate the Province's major gypsum and anhydrite production sites. Using Bell's (1929) subzones, they placed all active mines within the A and B Subzones (Giles, 1981a, Cycles 1 and 2). Several factors which localized these units include: (1) large component of CaSO_4 , (2) influence of structure concentrated at this level (decollement-collapse, etc.), (3) enhanced permeability due to structure and paleodrainage (geomorphology).

Although gypsum has been observed in drillcores from today's Windsor Group basins at depths up to 300 m below surface, virtually all gypsum horizons in the Province grade to anhydrite with increasing depth. In contrast to the primary depositional model proposed by Goodman (1952), it is generally accepted by most investigators (i.e. Schenk, 1969) that present day gypsum deposits primarily are the result of rehydration of anhydrite bodies. Whether the anhydrite is primary or secondary after original depositional gypsum is unclear. The spatial relationship and association with near surface environment, fracture-permeability aquifer zones and inferred burial depth below the stability of primary gypsum, as well as abundant replacement textures of gypsum after anhydrite, leave little doubt as to the origin of the gypsum. The time of rehydration varies from area to area and could have occurred at any time between the Carboniferous and the present as is evidenced by multiple episodes of karstification and associated solution

infilled materials found in the Cycle 1 and Cycle 2 horizons at various locations in the Province. Giles (1980) suggested that the Lakevale Formation found in the Antigonish Basin was probably deposited in karst features in Cycle 1 evaporites at some time not later than Namurian (Late Carboniferous Canso Group). Similarly Bochner's (1980a) discussion of solution infill material found in the same basal sulphate horizon at Crystal Cliffs, Antigonish County, reported spores of Stephanian (Late Carboniferous Pictou Group) age extracted from infill material.

Much younger Triassic material infills solution features studied by Clifton (1967) in the Windsor Basin. Unconsolidated Cretaceous aged deposits of clay, sand and lignite were reported by Dickie (1987) to be preserved in solution features in Cycle 1 and Cycle 2 at the following areas around the Province: Gays River, Halifax County; West Indian Road, Hants County; McKay Settlement, Hants County; and Diogenes Brook, Inverness County. All deposits of gypsum quarried at present in Nova Scotia have innumerable karst features over their upper surfaces infilled by Pleistocene aged materials and annually cases of sinkholes suddenly opening up on properties around the Province graphically show that dissolution of gypsum and anhydrite continues at present.

Sonnenfeld (1984) stated that "secondary gypsification requires meteoric waters" The hydration appears to be enhanced by the presence of porous interbeds adjacent to the anhydrite bodies, faulting of the anhydrite which may have enhanced its permeability, and differing patterns of overlying cover and drainage. Sonnenfeld (1984) also suggested that "the presence of barium, calcium, strontium or trivalent metal ions in the water will accelerate the hydration." It is also known that the presence of other substances such as calcium hydroxide will inhibit hydration.

Theoretically, mole for mole hydration of anhydrite to gypsum results in a 61% volume increase which could, in part, be responsible for some of the structural deformation which is observed within the Windsor Group strata. It is more likely that much of the excess gypsum is removed in solution as part of the throughgoing fluid system during the hydration process. Observations that chloride content of gypsum is usually lower than in the original anhydrite support this idea (removal of CaSO_4 and NaCl). Lewis and Holleman (1983) noted that the highest concentration of soluble salts are found in gypsum adjacent to anhydrite often as haloes 2-3 m in width. Sonnenfeld (1984) determined that solutions containing higher concentrations of salt will precipitate anhydrite rather than gypsum. It may be that meteoric

water which hydrated anhydrite and flushed salts as they moved downward, gradually became saturated so that they no longer hydrated the anhydrite until additional meteoric water was introduced.

A number of gypsum deposit types have been recognized during the course of this study. Two are seen in the Cycle 1 (A Subzone) and three are observed in Cycle 2 (B Subzone). **Type 1** surface rind/envelope involves the hydration of the massive basal anhydrite from the surface down (Fig. 1-2). Hydration usually extends 10-20 m below the top of the gypsum to an

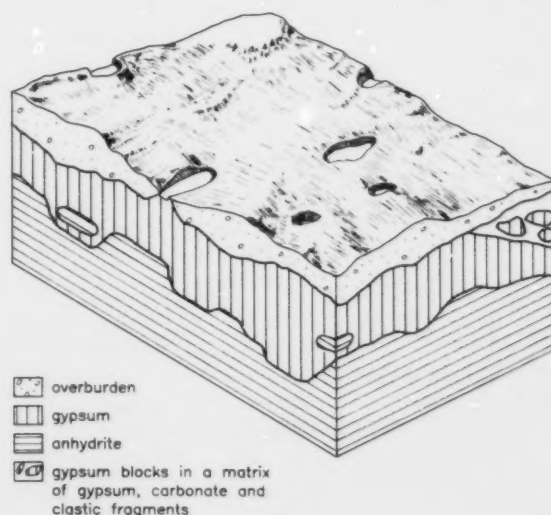


Figure 1-2. Deposit type 1 shows shallow surface hydration of massive basal anhydrite.

irregular interface with underlying anhydrite. This irregularity may reflect fracture/fault structures cutting the anhydrite, surface groundwater patterns or overburden cover having differing permeability. Interbeds of carbonate and clastics are rare, have limited permeability and thus have little influence as hydration fluid pathways. Examples of this type of deposit are Georgia-Pacific Corporation's Big Brook site at River Denys, Inverness County, and Fundy Gypsum Company Ltd.'s White Quarry at Wentworth, Hants County. Gypsum produced from these Quarries is a white, highly pure product. These deposits are usually of lesser volume than other types.

Deposit type 2 of Cycle 1 (A Subzone) is a modification of type 1. In addition to having thin surface hydration over the top of basal anhydrite, these deposits contain a much deeper (+30 m) trough of hydration which roughly conforms to the contact between the basal sulphate and the underlying basement (Fig. 1-3). At

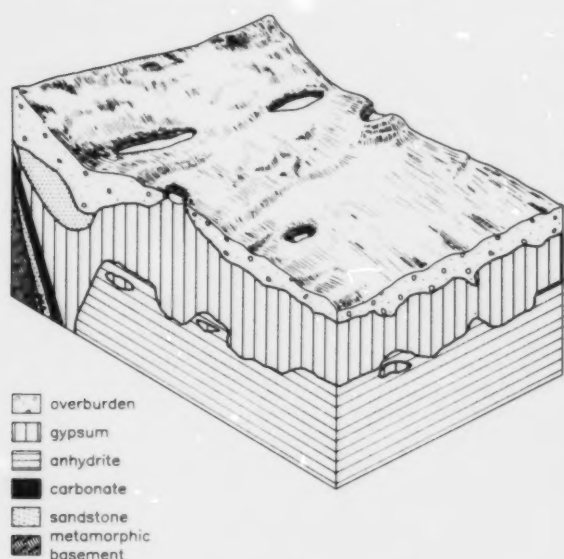


Figure 1-3. Deposit type 2 shows surface hydration and deeper hydration along contact between basal anhydrite and underlying porous units.

many places around the Province there is evidence that these features existed, the gypsum was removed by dissolution and the resultant trench was partially or totally infilled by younger material. Deposits like Domtar Gypsum's McKay Section Quarry in Hants County, Georgia-Pacific Corporation's Sugar Camp Quarry, Inverness County, and the drilled, but undeveloped deposits at Long Hill, Victoria County, held by Republic Gypsum and Domtar Gypsum all are this type. Gypsum from these deposits is a white, highly pure variety equal in quality to the first type; the volume of these deposits depends on how deep hydration extended and how much of this trench material has remained in place. Due to the enhanced hydration thickness from water concentration down the basal contact, they tend to be larger than the first type, but still are smaller than the deposits of Cycle 2.

There are (at least) three separate types of gypsum deposits found in Cycle 2 (B Subzone). Primarily, they differ in the degree and style of deformation of the strata in which they are confined. All three types are confined to the lowermost portion of Cycle 2 where the calcium sulphate interbeds comprise up to 75% of the geological section. Carbonate and clastic interbeds make up the remainder and are considered as waste material to be discarded during the mining process.

Deposit type 3 consists of gently-dipping interbedded calcium sulphate horizons with interbeds of carbonates and fine grained clastics (Fig. 1-4). These deposits are

rare since most of the Cycle 2 sections in most of the subbasins are moderately to highly deformed. Calcium sulphate beds 10-20 m thick, dip gently ($8-10^\circ$) to the northeast in the Meadows Road area, Cape Breton County. Hydration extends downdip to a point approximately 30 m below surface. A few drillholes have been put down into this section at Meadow Road, however insufficient information is available to comment on the volumes of gypsum which might be extractable. This deposit type would most likely be amenable to underground, room and pillar mining only and as such would be more expensive than any of the other deposit types. Gypsum quality is good here and is generally white to light grey in colour.

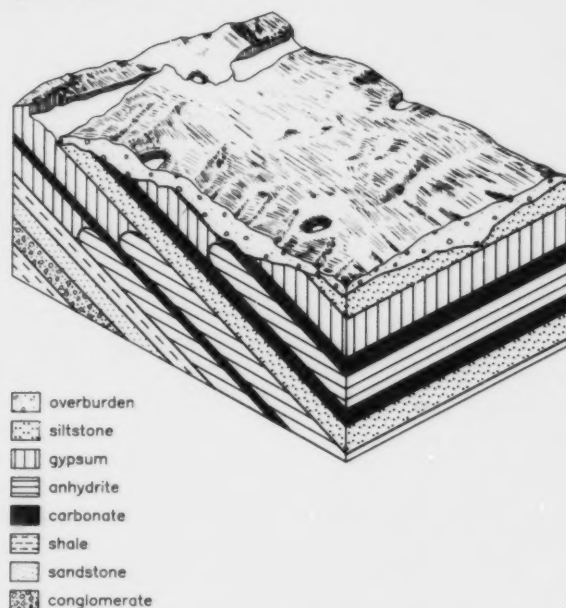


Figure 1-4. Deposit type 3 shows deep hydration of anhydrite between more porous interbeds.

Deposit type 4 is comprised of type 3 strata structurally deformed to produce a folded and faulted section (Fig. 1-5). Structural mechanisms previously mentioned enhance the permeability of these sections which results in greatly increased depths of hydration in excess of 100 m. Degree of deformation varies from a broad plunging syncline in the Little Narrows Gypsum Company Ltd.'s Magazine Quarry at Little Narrows, Victoria County, to a recumbently folded and faulted section at Fundy Gypsum Company Ltd.'s Miller Creek Quarry. Gypsum taken from this type of deposit is usually light to dark grey in colour and varies from very fine grained to selenitic. Interbeds of carbonate and clastic materials are usually removed from the quarry during the mining operation and some fine grained

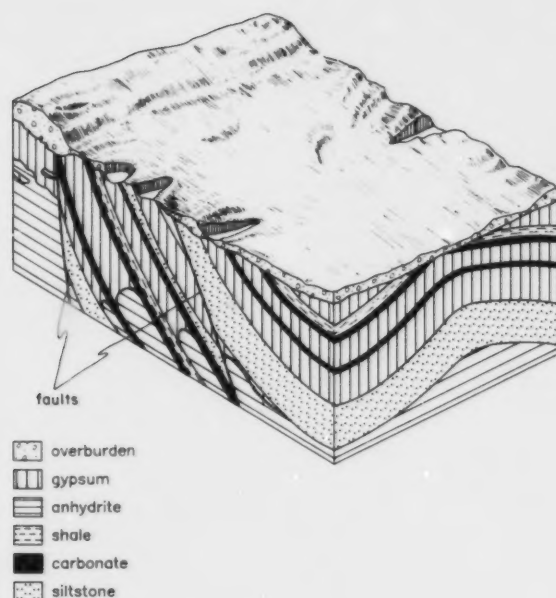


Figure 1-5. Deposit type 4 shows hydration enhanced by structural deformation (folding and faulting).

waste material is screened after crushing has occurred. Final products are dark and less pure than those generated from all previously described deposit types.

Type 5 occurs in the same strata near the base of Cycle 2 (B Subzone) as is seen in types 3 and 4, however the deformation and disruption of the beds is so complete that little remains of the original beds which made up the section (Fig. 1-6). The mechanisms which produced these deposits are still unclear; Boehner (in press) and Moore (1967) proposed faulting, either thrusting or decollement, and Howie (1986) proposed brecciation after the dissolution of halite horizons; perhaps both processes were involved. Whatever the mechanism, these deposits are generally large (+50 Mt thick), with +100 m depths of hydration. They are quite homogeneous in composition and thus are less complicated and more straightforward to mine than any other type. The grade and character of the gypsum is the same as in type 4, however all impurities (carbonates and clastics) must be removed in the crushing and screening process rather than by the selective mining practised in type 4. Occasionally, larger blocks of carbonate can be avoided in mining, but generally everything is removed from the quarry. National Gypsum (Canada) Ltd.'s East Milford Quarry in Halifax County is an example of type 5 and a similar deposit has been outlined nearby at Dutch Settlement, Halifax County, by Fundy Gypsum Company Ltd. Type 5 deposits are also known to exist

adjacent to the Big Brook and Sugar Camp Quarries of Georgia-Pacific in Inverness County.

Undoubtedly there are more types of deposits of gypsum and anhydrite present in the variably deformed Windsor basins in the Province. Recognition of these deposit types as well as the stratigraphic and structural parameters and processes which have produced them should aid in extending the reserves of present quarries and help to delineate new ones.

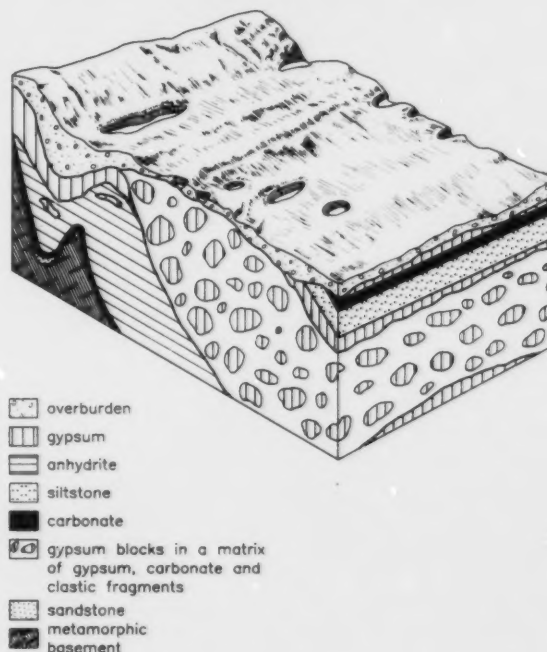


Figure 1-6. Deposit type 5 shows massive disruption of original beds allows hydration in excess of 100 m below present day surface.

HISTORY OF GYPSUM/ANHYDRITE MINING IN NOVA SCOTIA

How (1869) stated that gypsum operations had been active in the area of Windsor, Hants County, for 80-90 years. This puts commencement of the commercial gypsum industry at 1778-1788 and confirms that the gypsum industry has been active in Nova Scotia for over 200 years. In that time, the Province has become the most productive gypsum mining region in the world. Total Nova Scotia gypsum production recorded between 1862 and 1987 was more than 193 Mt with approximately 160 Mt produced between 1950 and 1987.

In the early years, the gypsum industry consisted of farmers who had gypsum/anhydrite exposures on their

properties in the Windsor area. They would extract blocks of material and haul it by horse and cart to shipping points near Windsor. There, the soft or hard plaster (gypsum or anhydrite) was sold to local traders and shipped on vessels to various points along the eastern seaboard of the United States where it was commonly used as fertilizer.

During the early 1800s political developments occurred which were to change the face of the gypsum industry in the Province. In 1826 King George IV granted his brother the Duke of York the right to all minerals in Nova Scotia which had not previously been granted. These rights were, in turn, given to a group of his creditors who formed the General Mining Association. Public pressure on the legislative assembly of Nova Scotia in 1856 resulted in the sending of a delegation to petition the Parliament in London to rescind mineral grants given to the Duke of York. The legislative assembly introduced and eventually passed a bill in 1858 which repealed those mineral grants, however it exempted limestone, plaster (gypsum) and other building materials. The results of this were that gypsum has since that time belonged not to the government, but to the owner of the property and in 1858 individuals and companies began to purchase gypsum 'rights' from landowners (King, 1985).

Through the acquisition of quarries and gypsum rights the gypsum industry began to become consolidated into the hands of a small group of companies by the late 1800s. One direct result of this was the development of gypsum operations elsewhere in the Province (i.e. Cape Breton Island) at the end of the nineteenth century. During this period technological advances occurred in the industry which lead to increased productivity in the quarries. In 1882 a locomotive was first used in the Windsor area to haul stone from the quarry to dockside replacing horse drawn carts. In 1885 a commercial process was developed to retard the set of gypsum plaster. The first calcining mill in Nova Scotia for the commercial production of plaster was constructed in Windsor in 1888 by the Windsor Plaster Co. (a plant which is operated today by Domtar Gypsum). The Great Northern Mining Company built the Province's second plaster mill at Chéticamp, Inverness County, in 1907. It operated sporadically until it was finally closed in 1926. Overburden stripping using a steam shovel was first carried out in the Windsor area in 1908. Prior to this, it was blasted down with the stone and sorted in the quarry. A third plaster mill was constructed at Grassy Cove just north of Iona, Victoria County, in 1914. It was operated by the Iona Gypsum Company until its closure in 1933 (King, 1985).

In 1918 a process was developed in the United States to sandwich a layer of plaster between two sheets of paper to form plasterboard (Schroeder, 1970). Large scale production took ten more years but this product revolutionized the construction industry and in doing so, changed the gypsum production industry of Nova Scotia. By the 1930s the vertically integrated, multinational corporations which dominate gypsum production in the Province, began to acquire most of the quarries and gypsum rights that they now hold. Economy of scale prevailed as quarries became larger and more productive; small operations closed. Equipment became larger and more sophisticated as demand for more stone and cheaper stone grew and grew. By the late 1930s most of the companies presently involved in the gypsum business in Nova Scotia had established their positions for the next 50 years or more.

Currently in excess of 7 Mt of gypsum and anhydrite are produced in Nova Scotia annually (Vagt, 1989). Of this material 99.8% is exported to foreign (United States) and domestic markets for secondary processing. Four companies producing from six quarry sites account for 99.3% of total production. Heavy mobile equipment is used to drill, blast, load, haul, crush and move material from the quarry to loadout facilities. Three unit trains and a fleet of trucks transport products from the quarry to company owned shipping facilities from which company owned and chartered vessels take gypsum and anhydrite to market. Gypsum and anhydrite production has evolved into a large scale, capital intensive, highly mechanized business; with little apparent similarities to the original operations run by the farmers of eighteenth century Hants County.

PRESENT DAY OPERATIONS

Six companies were quarrying Nova Scotia's gypsum and anhydrite in 1986 including: National Gypsum (Canada) Ltd., Fundy Gypsum Company Ltd., Georgia-Pacific Corporation, Little Narrows Gypsum Company Ltd., Domtar Gypsum and Nova Construction Company Ltd. (Fig. 1-7). These operations produced 6.5 Mt of gypsum and anhydrite in 1987 and employed 486 people (Nova Scotia Department of Mines and Energy, 1988).

National Gypsum is the largest producer, quarrying in excess of 3.0 Mt in 1987 at the largest producing gypsum quarry in the western world situated at East Milford, Halifax County (Nova Scotia Department of Mines and Energy, 1988). Following crushing and screening at East Milford, the gypsum is transported by Canadian National Railway 42 km to Burnside, Halifax County. On the average three 'unit trains' carrying

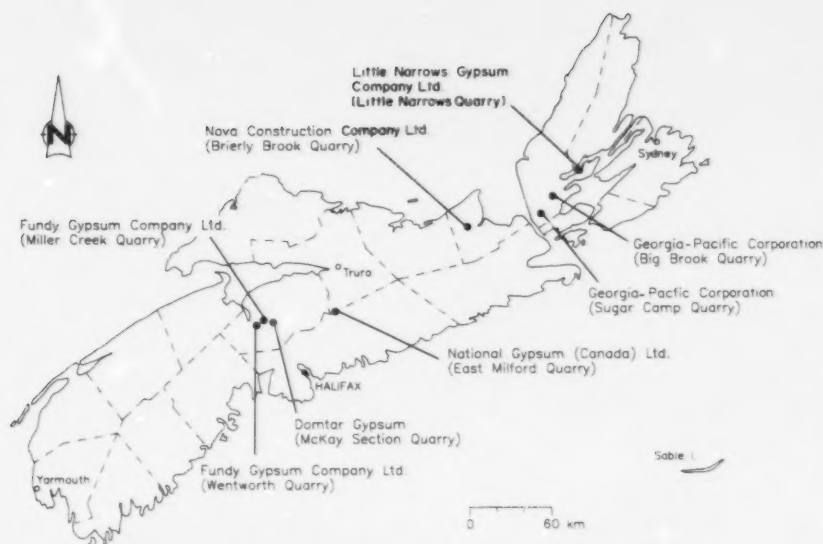


Figure 1-7. Present day gypsum and anhydrite operations.

4500 t each make the trip to National's loading facility at Wrights Cove on the eastern side of the Bedford Basin each day. Upon their arrival at this facility each boxcar is dumped and the gypsum is transferred by a stacker to a large stockpile and in turn it is loaded onto company owned or chartered ships at its loading dock. These ships, generally between 18 000-27 000 t capacity, are loaded from the stockpile by a movable conveyor system which works at up to 4000 t per hour.

Fundy Gypsum runs two separate quarrying operations in the Windsor, Hants County area, which produced a total of 1.6 Mt of gypsum and anhydrite in 1987 (Nova Scotia Department of Mines and Energy, 1988). Production at Wentworth, Hants County, is unique in that both white gypsum and anhydrite are produced using its sink-float (heavy media) beneficiation plant. These products are shipped 16 km along the Dominion Atlantic Railway (Canadian Pacific Railway) to Fundy's shipping terminal at Hantsport. The Miller Creek Quarry at Mantua, Hants County, generates most of Fundy's gypsum production. Its dark gypsum is crushed and screened, then shipped 24 km by rail to the Hantsport facility. The Hantsport loading terminal is unique in that its 11.9 m tidal range permits a maximum of three hours in which to load up to 15 000 t of rock during high tide. Twin conveyor-loaders with movable booms can load ships at a rate of 6500 t per hour, allowing ships to dock, load and depart on the turning tide.

Georgia-Pacific Corporation has its active quarry at Big Brook and is developing a new quarry at Sugar Camp, both in Inverness County. In 1987 it produced

0.86 Mt of gypsum (Nova Scotia Department of Mines and Energy, 1988) which, after crushing and screening, were shipped 32 km by Canadian National Railway to its loading terminal at Point Tupper. Production from its new quarry is hauled by truck instead of rail to Port Hawkesbury. Due to its location on the ice free, deep water Strait of Canso, Georgia-Pacific's loading facility can accommodate ships up to 30 000 t. A fixed discharge conveyor loads its company owned vessels at a rate of 2300 t per hour.

Little Narrows Gypsum also produces both gypsum and anhydrite. The total output for 1987 was 1.2 Mt from its quarry at Little Narrows, Victoria County (Nova Scotia Department of Mines and Energy, 1988). A new quarry, presently under development, is located just to the east of the operating quarry. After crushing and screening, the rock is moved by conveyor to a covered stockpile beside its dock on St. Patricks Channel. Company owned and chartered vessels capable of carrying up to 25 000 t of rock are loaded by a movable conveyor system. Channel restrictions in the Big Bras d'Or Channel limit the size of vessel able to ship out of Little Narrows and winter ice on the Bras d'Or Lakes can also be a problem some years.

Domtar Gypsum of Windsor operates a small quarry in McKay Section, Hants County, with 1987 production amounting to just over 11 000 t of gypsum (Nova Scotia Department of Mines and Energy, 1988). Domtar is the only Nova Scotia operation that undertakes any processing of gypsum. Its small calcining plant produces a variety of plaster finishing products and 'gypcrete'.

The newest production operation in the Province is that of Nova Construction at Brierly Brook, Antigonish County. Its production is aimed at the spot market and therefore is sporadic.

ALTERNATE UTILIZATION

Although Nova Scotia's gypsum/anhydrite industry has been operating for over 200 years, most of the material produced in the first 120 years was used as fertilizer or soil conditioner, a market which, although small, still exists today. The use of gypsum plasters became popular

in the late 1800s and that market, again a small one, exists today as is evidenced by one small plaster mill (Domtar Gypsum) in operation as well as white gypsum produced and exported by Fundy Gypsum from its Wentworth Quarries, Hants County. The bulk (+90%) of today's gypsum and anhydrite production in the Province goes to the wallboard and cement industries, 98% of which was exported out of the Province in 1987.

Two motives were behind the efforts to investigate alternate utilization of gypsum and anhydrite as part of this investigation. Primarily, new uses could lead to expanded or new production of these commodities. This in turn could lead to additional secondary processing of gypsum and anhydrite within the Province. At the outset of this project, approximately 0.30% of total production was processed in Nova Scotia to any degree more than coarse crushing, 0.18% was used in cement and 0.12% calcined for plaster products.

The first area investigated was in agricultural applications of gypsum and anhydrite. Information was gathered on scientific research in this field, potential contacts in regional government agricultural agencies and potential markets (Luke, 1986). Provincial Department of Agriculture representatives indicated that with minimal research they could support gypsum/anhydrite use as: (1) a Ca and S source, (2) an additive that would help break up certain types of clay-rich soils, and (3) a product which would help remove salts from dykeland soils or heavily irrigated soils. They believed that an initial market of 20 000 tpa existed for such applications within the Province. The utilization potential has not yet been researched or exploited. As yet no companies have been willing to support the local research required to develop these markets.

Investigations into the use of local anhydrite as a cementitious construction material in underground coal mines have proven far more fruitful. Literature research conducted in early 1986 established that anhydrite had been used in West German coal mines for up to 15 years as a construction material for gateside packs, stoppings and roadway backfill. A project was then proposed jointly by researchers at the Technical University of Nova Scotia (TUNS) and the Nova Scotia Department of Mines and Energy (NSDME) to determine whether indigenous anhydrite could be used in the same way in the coal mines of Cape Breton.

A contract was awarded to TUNS in late 1987, funded by the Canada-Nova Scotia Mineral Development Agreement (MDA) which was administered by the Canada Centre for Mineral and Energy Technology (CANMET). Samples of anhydrite from four sites were

tested using information from the limited literature available from West Germany and the United Kingdom. Laboratory testing consisted of uniaxial compressive strength tests on various anhydrite/accelerator/water mixes which were cast in moulds to form blocks to simulate in situ loading conditions in underground coal mines. Since no standards for these materials currently exist in North America the TUNS efforts were greatly assisted by information gained from the West German coal mine research institute, Bergbau-Forschung GmbH.

Results of this research (Jones et al., 1989) showed that, if properly prepared, anhydrite from Little Narrows, Victoria County, could perform as well as, or better than, known European anhydrite products. During the latter stages of work at TUNS interest was shown in the project by Cape Minerals Ltd. of Sydney, Cape Breton County. Cape Minerals Ltd. promoted the idea to the Cape Breton Development Corporation (CBDC) as a means of replacing more expensive imported materials such as hardwood chocks and portland cement-based monolithic packing materials presently being used.

A surface trial of the anhydrite-based gateside pack system was carried out early in June 1989 by Cape Minerals Ltd. Further subsurface trials were undertaken in October and November of 1989 with promising results. If the anhydrite cementitious material proves suitable, it may be instrumental in CBDC's plans to extend the lifespan of the Langan Colliery by introducing pillarless retreat mining in the near future. Should this transpire >10 000 tpa of anhydrite could be used at Langan Colliery for gateside packs alone. Additional tonnages might also be used in other construction applications at Langan and this could easily double if it were used at other CBDC mines.

The success of this research has led to additional research on anhydrite at TUNS. TUNS is currently investigating the possibility of making wallboard products from anhydrite plasters as well as using anhydrite plasters in selflevelling flooring systems (i.e. poured floors). Further studies have already been proposed to investigate the potential use of anhydrite materials in backfill applications in base metal mining where it would replace portland cements at half the cost. Other possibilities include possible replacement of cement in other applications where the material is not exposed to excessive moisture. Potential for marketing anhydrite-based cementitious products, especially to replace, in part, portland cement products, looks very good at this time.

Other possibilities which should be investigated in the near future are the establishment of a mill in Nova Scotia which could utilize the high purity, white gypsum

of Cycle 1 (A Subzone) to fabricate plaster and ground gypsum products. New technology in plasters have developed which produce stuccoes having an extended shelf life and therefore can be transported longer distances to markets. Very finely ground, uncalcined white gypsum is finding more and more applications as a filler in plastics, adhesives and paints as well as a coating for papers in pH sensitive processes (Luke, 1990).

In general the prospects for developing additional markets for gypsum and anhydrite look very good. New products developed and fabricated in the Province should help to defray much of the predicted reduction in overall production as byproduct gypsums become more widely accepted in the marketplace.

BYPRODUCT GYPSUM

Slowly but steadily, gypsum produced as a byproduct of the production of phosphoric, hydrofluoric and citric acids, from the desulphurization of flue gases and the treatment of wastes from titanium dioxide and sulphide ore smelting is replacing natural gypsum in the world's marketplaces. At present the greatest source of byproduct gypsum is the phosphate industry which, on the average, generates 4.5 t of phosphogypsum for every 1 t of P_2O_5 , or 117 Mt worldwide in 1985 (Roskill Information Services Ltd., 1987). Although not yet of similar magnitude, the production of flue gas desulphurization (FGD) gypsum, spurred on by concern over the reduction of acid rain emissions, will eventually surpass that of phosphogypsum that is currently produced worldwide.

Japan has been at the forefront of byproduct gypsum utilization since the mid 1970s. Limited natural resources there were gradually replaced by phosphogypsum during the early 1970s and eventually all production from natural sources ended in 1977. Japan is still one of the few countries which utilizes phosphogypsum although it produces only 1.6% of the world's total phosphogypsum. Also, during the mid 1970s the Japanese government actively supported research and development work on FGD techniques and FGD gypsum utilization. By 1987 (Hara, 1988) Japan's total supply of gypsum was 7.3 Mt of which phosphogypsum was 29.7%, FGD gypsum 23.6% and imported crude gypsum 23.6%. Gypsum demand, mainly for the cement and rapidly growing wallboard industries, consumed 98.0% of available supplies.

Elsewhere around the world byproduct gypsum utilization has been much slower in developing. By 1983 environmental regulations were emplaced in West

Germany to force the reduction of SO_2 and NO_x emissions in power plant stack gases. Highly dependent on coal fired generating stations, the West Germans will be producing 2.5 Million tpa of FGD gypsum by 1990. Restrictions on dumping of this product in landfills or waterways has forced the utilities to produce gypsum suitable for consumption by the cement and plaster industries. At present small amounts of FGD gypsum are being used, mainly by the cement industry, but Stein (1988) believed that in the long term over 1.4 Million tpa will enter the markets in West Germany chiefly to replace declining natural resources. Little information is available in phosphogypsum production and consumption in this country.

Although moving towards reducing emissions, regulations in this regard were not introduced in the United Kingdom until June 1988. There the Central Electricity Generating Board (CEGB) which produces most of the United Kingdom's electrical power uses mainly coal fired units. Halstead (1988) indicated that by the year 2000 they will have 20 000 MW of FGD plants operating or under construction. These would generate approximately 5.0 Million tpa of FGD gypsum. At present United Kingdom sources produce over 1 Million tpa of phosphogypsum and current consumption of gypsum is in the vicinity of 4 Million tpa. Production from natural sources, of 3.2 Mt in 1985 (Roskill Information Services Ltd., 1987), is supplemented by imports from Ireland, Morocco and Spain. CEGB is presently investigating potential markets for their FGD gypsum as well as researching environmentally acceptable ways to handle the material which cannot be sold.

In the United States phosphogypsum has long been a problem in the phosphate producing areas of the country (Florida, North Carolina, Idaho, Tennessee, Montana and Utah). In 1987, 37 Mt of phosphogypsum were produced by this industry, most of which was added to the existing 300 Mt presently in stockpiles. Reduction of power plant emissions is also on the increase in the United States and although Environmental Protection Agency regulations have not yet been enacted, coal fired utilities are presently moving to reduce their emissions through FGD retrofitting or new FGD equipped installations. Mosher et al. (1988) suggested that by the turn of the Century 100 000 MW of generating capacity in the United States will be equipped with FGD systems having the potential to produce 25 Million tpa of FGD gypsum. This alone would be adequate to supply all of the country's gypsum requirements now supplied by domestic (14.9 Mt) and foreign sources (8.8 Mt) without even considering the available phosphogypsum.

Information is not readily available for byproduct gypsum production and consumption from other nations. However, as with natural gypsum production, every country in the world is at present producing or has the potential to produce, byproduct gypsum. Ever increasing environmental public awareness is forcing governments around the world to establish regulations regarding coal fired generating stations' emissions. Landfills and ocean and river dumping of chemical byproducts are also becoming the subject of regulations.

Under normal market conditions byproduct gypsum would have to compete with natural stone on an even playing field. Most of the gypsum produced in Nova Scotia is shipped to wallboard plants located along the eastern seaboard of the United States and most of the mines and plants are owned by two large multinational companies. Power utilities which produce FGD gypsum must invest substantial amounts of money to produce a gypsum that is acceptable to the wallboard producers which will increase the cost of this gypsum. They must also provide a steady volume and quality of gypsum to the wallboard plants, however variations occurring in the generating patterns and coal supplies can greatly affect these parameters. Finally, shipping FGD to wallboard plants must not increase the cost beyond the point where it can compete with natural gypsum. Much of the electrical generating capacity in the eastern United States is not located close to present wallboard plants.

Rising public awareness with regard to the environment will undoubtedly change governmental regulations and eventually force increased utilization of byproduct gypsum. This, in turn, will negatively affect markets for natural gypsum, especially imported stone. Two factors will greatly influence this scenario and thus the effects on Nova Scotia's gypsum mining industry: changing markets and changing technology. With regard to markets, all companies now faced with generating and disposing of large volumes of byproduct gypsum are researching alternate ways to utilize this product. New gypsum-based products and new processes to utilize gypsum are under investigation with new developments being found constantly.

Public concerns over CO₂ emissions are spurring on further research into clean coal technology. Recent developments in the field of coal gasification have resulted in a number of techniques under the heading of Integrated Gasification Combined Cycle (IGCC). This process is cost comparative with FGD equipped regular coal fired generating plants. It is significantly more efficient in generating power, using less fuel and producing fewer emissions (CO₂, SO₂ and NO_x). Gases are cleaned within the system and so generate less

particulate emission. This technology is usually set up to recover elemental sulphur instead of byproduct gypsum which in all normal FGD systems is generated at the expense of producing even more CO₂.

The United States Bureau of Mines forecasts a gradual decline in the United States phosphate industry as environmental concerns and domestic production costs gradually increase while cheap foreign imports increase. The United States phosphate industry representatives do not always agree with United States Bureau of Mines predictions, however these producers of phosphogypsum are also investigating ways to utilize this byproduct.

Accurately predicting the future of byproduct gypsum production and its effects on natural gypsum production is virtually impossible. Technological changes are occurring so rapidly that processes in place today may be outdated in the near future. Public concerns about the environment may force dramatic changes in the industries that are producing byproduct gypsum. Without doubt byproduct gypsum will eventually displace some of the natural gypsum presently being consumed. To what extent this will take place in those North American markets supplied by Nova Scotia's mines is uncertain. The implementation of FGD technology will take time during which new technologies such as IGCC may surpass conventional scrubbing techniques. It is conceivable that gypsum production from Nova Scotia's mines might not suffer any prolonged decline caused by developments in byproduct gypsum.

ORGANIZATION AND CONTENTS OF THIS REPORT

Chapters 2-12 contain descriptions and preliminary evaluations of all those deposits and occurrences of gypsum or anhydrite, or both, which have been investigated during the course of this study. Map 91-1, an overall location map, can be found in a pocket at the back of this report. Without doubt some occurrences do exist that have not been examined. Some areas along the Atlantic Coast in Lunenburg County, underlain by Windsor Group sedimentary rock, purportedly show karst topography and minor gypsum exposures which could not be verified. Several small exposures of gypsum, known to exist along the northern shore of the Minas Basin, east of Parrsboro, Cumberland County, were not investigated. As additional information is gathered from around the Province, the data accumulated in this study will be updated.

The following descriptions have been organized by county with each county's occurrences presented in

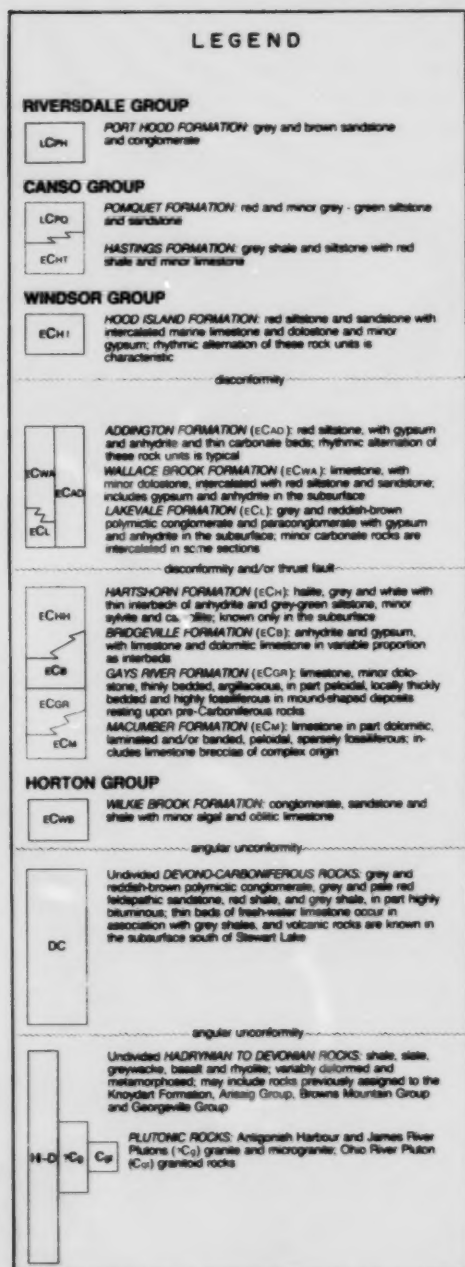
alphabetical order. Appendix 1 is a list of occurrences ordered by NTS. Each occurrence has been assigned an individual reference number by which it is identified on Map 91-1 found in the back of this volume as well as on each county location map. Appendix 2 is a list of occurrences ordered by reference number. These reference numbers are also used to locate analytical data for hand specimens and drill core samples pertaining to individual occurrences which can be found in Appendix 3. Hand specimens were collected from all exposures visited during field seasons 1986 to 1989 inclusive. Samples were sent to the Minerals Engineering Centre at the Technical University of Nova Scotia for analyses. Samples submitted were air dried, pulverized and tested

for moisture, combined water, SO_3 , and NaCl . The percentages of gypsum and anhydrite were then calculated. The NaCl content was determined because of its deleterious effects in the gypsum wallboard manufacturing process. Drill logs of previously completed drillholes which were sampled, that pertain to specific occurrences, can be found in Appendix 4.

Each description combines information gathered from surface exposures, assessment reports, drill logs, open file reports and theses accumulated between 1985 and 1989. Also, each writeup includes an appraisal of the resource potential of the occurrence.



CHAPTER 2. ANTIGONISH COUNTY



after Boehner and Giles, 1982

Figure 2-1. Geological legend for Antigonish County gypsum and anhydrite occurrence maps.

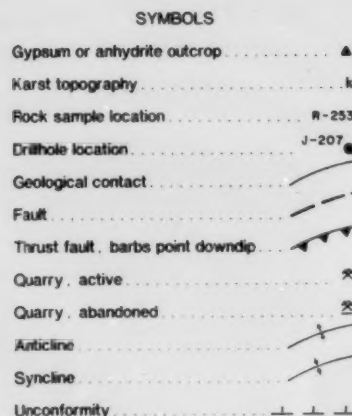


Figure 2-1. Continued.

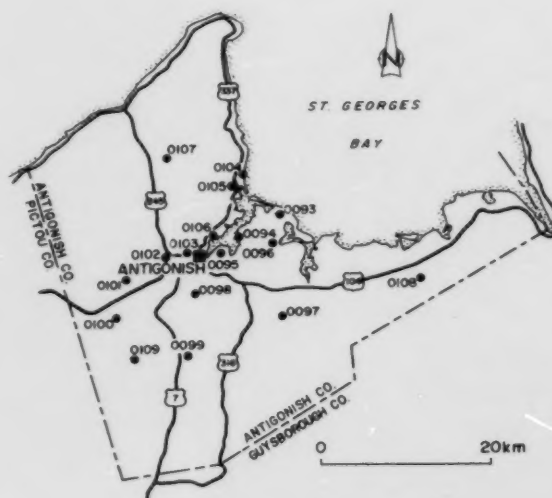
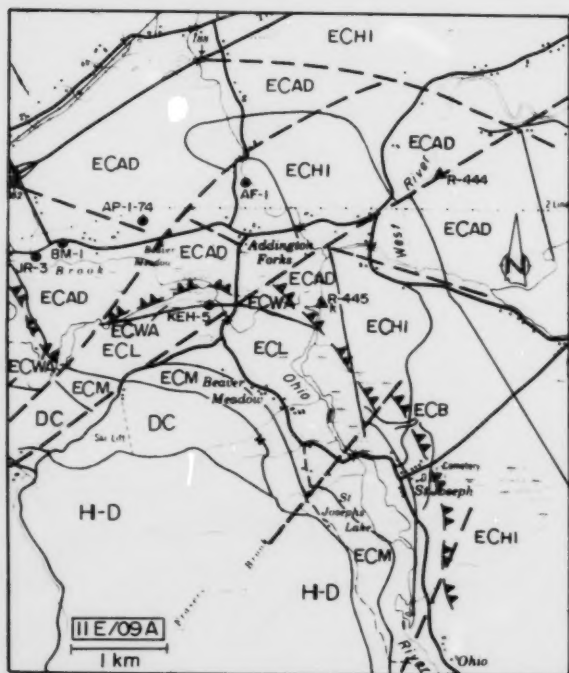


Figure 2-2. Location map for Antigonish County gypsum and anhydrite occurrences by reference number.

ADDINGTON FORKS (0100)
 NTS 11E/09A
 UTM 571100 E 5044800 N

The Addington Forks occurrence area is located 8 km southwest of the Town of Antigonish, Antigonish County (Fig. 2-3). It includes the following two separate surface outcrop areas: one found along the banks of the West River and the other at the northern end of St. Josephs Lake. Calcium sulphate units were also encountered in five diamond-drill holes.



Geology after Boehner and Giles, 1982

Figure 2-3. Location and geology of the Addington Forks occurrence area. See Figures 2-1 and 2-2 for legend and location.

Boehner (1986) included much of this area in his writeup on the James River salt deposit. A more detailed geological interpretation can be found there. The Addington Forks occurrence area is underlain by units of the Hood Island and Addington Formations on the surface and the underlying Hartshorn and Bridgeville Formations in the subsurface. The area is cut by numerous faults in various styles which complicate geological interpretation.

Regional geological mapping by Boehner and Giles (1982) placed two outcrops of gypsum/anhydrite in this area in the Addington Formation. One is found on the eastern bank of the West River 1.5 km downstream

below the Forks Road bridges. It consists of a 3-4 m thick gypsum bed which is exposed over a length of 10 m. Approximately 2 km to the southwest a second sulphate exposure can be found at the northern end of St. Josephs Lake. A large outcrop approximately 100 m in length and up to 25 m in height can be found at this point. The majority of this exposure consists of anhydrite with the upper surface consisting of high purity gypsum. The apparent thickness of this calcium sulphate section and drilling suggests that it may belong to the Bridgeville Formation rather than the Addington Formation.

Five drillholes, from five separate exploration programs, have been put down in the Addington Forks area (Boehner, 1986). Using the stratigraphic information derived from these holes, Boehner (1986) determined that the Hood Island and Addington Formations had been moved over the Hartshorn and Bridgeville Formations along the Antigonish Thrust Fault in this area. The geology is further complicated by the Lakevale Formation which is believed to be an intraWindsor (Cycle 2) solution collapse-karst infill sequence which locally may surround and overlie a highly dissolved Bridgeville Formation. Only Amax Exploration's AP-1-74 (Amax Exploration Inc., 1974a) and Cuvier's BM-1 hole (Black, 1981) actually penetrated through the salt rich Hartshorn Formation into the sulphate dominated Bridgeville Formation.

The highly faulted nature of the rocks seen in the Addington Forks area mean that hydration of thicker anhydrite units is probably enhanced. However, these units are displaced by faulting and are therefore much smaller in size. In general, the area is of much geological interest, but of little economic interest. The area at the northern end of St. Josephs Lake may warrant some additional work.

ASHDALE (0099)
 NTS 11E/09A
 UTM 576600 E 5040000 N

The Ashdale occurrence is located 12 km south of the Town of Antigonish, Antigonish County, just east of Route 7 (Fig. 2-4). A second, lesser occurrence is also noted approximately 2.5 km south of the first at Glen Alpine. The primary occurrence consists of a series of minor outcrops and karst topography which trend 050° over a distance of several hundred metres. The second is only a very small <0.5 m² outcrop beside Route 7.

Regional mapping by Boehner and Giles (1982) indicated that the main Ashdale occurrence is located on the southern side of the Ashdale Anticline just north of

the northeasterly trending Pomquet Harbour Fault. The area is underlain by units of the Addington Formation which is overlain to the northeast and southwest by the clastic dominated Hood Island Formation and in fault contact to the southeast with the same Formation.

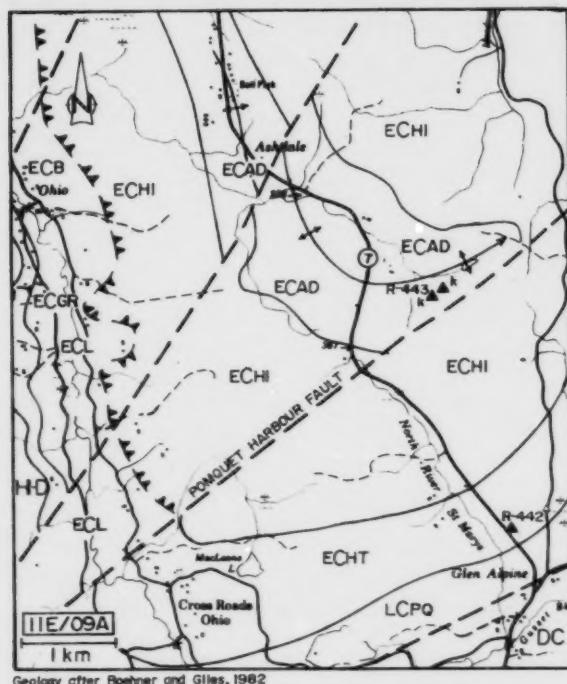


Figure 2-4. Location and geology of the Ashdale occurrence area. See Figures 2-1 and 2-2 for legend and location.

The Glen Alpine occurrence is found in units of the Canso Group Hastings Formation which is underlain to the north by Upper Windsor Hood Island Formation and overlain to the south by Upper Canso Pomquet Formation (Boehner and Giles, 1982).

The Ashdale occurrence is sufficiently interesting to warrant further investigation. Drilling could determine the thickness of the sulphate horizons present here. The small occurrence to the south at Glen Alpine is of geological interest.

BEECH HILL (0098)

NTS 11F/12B

UTM 580860 E 5048900 N

The Beech Hill occurrence is located 2-3 km southeast of the Town of Antigonish, Antigonish County (Fig. 2-5). It consists of two separate outcrops: one beside the road through Beech Hill and the other 1.2 km up a small tributary of the West River.

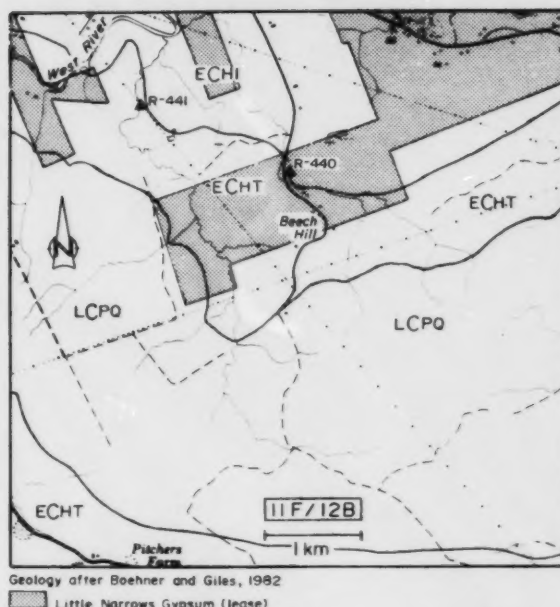


Figure 2-5. Location and geology of the Beech Hill occurrence area. See Figures 2-1 and 2-2 for legend and location.

Regional geological mapping by Boehner and Giles (1982) indicated that both these exposures lie along the contact between the Upper Windsor Hood Island Formation and the overlying Hastings Formation of the Canso Group. There are no diamond-drill holes in this area to provide further information on the local stratigraphy.

This locale is of no economic interest because the units found here do not contain sufficient sulphate thicknesses to be viable. It is, however, of geological interest.

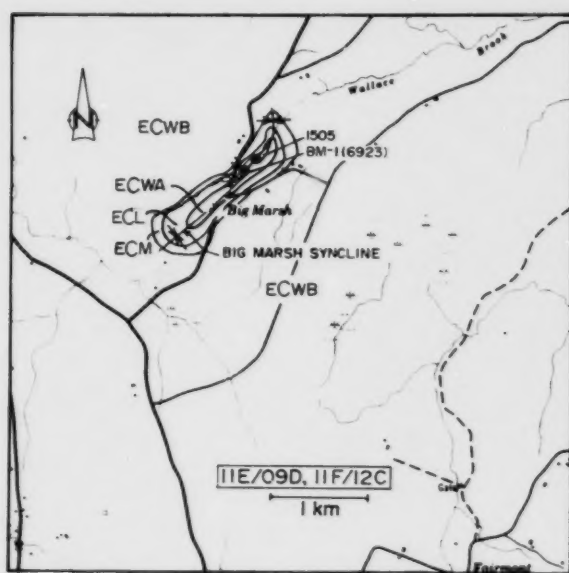
BIG MARSH (0107)

NTS 11E/09D

UTM 577050 E 5064800 N

The Big Marsh occurrence is a subsurface occurrence located 12 km north of the Town of Antigonish, Antigonish County (Fig. 2-6). It is found in a small outlier of Windsor Group rocks which are totally surrounded by what is believed to be Horton Group clastics (Boehner and Giles, 1982).

Mapped by Boehner and Giles (1982), the Big Marsh Syncline shows an area 1.8 km long by 300-500 m wide underlain by the Windsor Group. The two drill-holes put down in the middle of this Syncline passed through portions of the Wallace Brook, Lakevale and Macumber Formations of the Windsor Group before



Geology after Boehner and Giles, 1982

Figure 2-6. Location and geology of the Big Marsh occurrence area. See Figures 2-1 and 2-2 for legend and location.

entering the underlying Horton Group clastics. Two anhydrite beds were encountered in the subsurface, one 16 m thick at a depth of 105 m and a second 6 m thick approximately 8 m below the first. Neither bed is seen at surface or even suggested by surface topography. The Big Marsh occurrence is of geological interest and not of economic interest.

BRIERLY BROOK (0101)

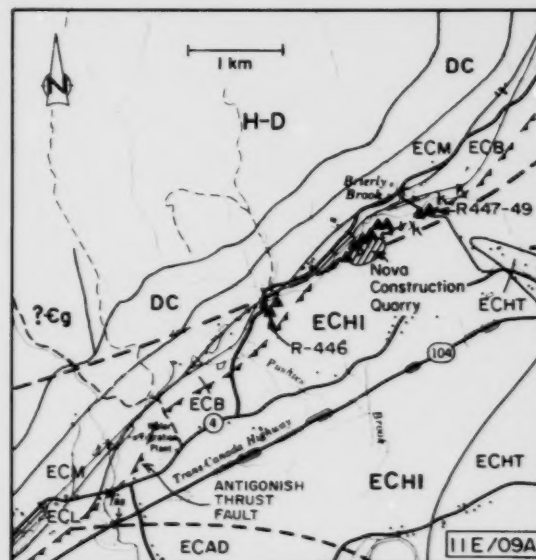
NTS 11E/09A

UTM 572500 E 5050400 N

The Briery Brook area is located 5 km southwest of the Town of Antigonish, Antigonish County (Fig. 2-7). Historical records show that some gypsum was produced in the Antigonish area between 1873 and 1979. Williams (1914) mentioned that gypsum was produced from the Briery Brook area. Recent drilling by Nova Construction Company Ltd. led to the development of a new quarry in the area which went into intermittent production in late 1986. It presently holds the gypsum rights to a small area in the vicinity of its operations.

Regional geological mapping by Boehner and Giles (1982) placed the mine section worked at Briery Brook in the Bridgeville Formation of the Windsor Group. It is underlain to the north and northwest by carbonates of the basal Macumber Formation and subsequently by undivided Devonian-Carboniferous clastics. The sulphate dominated Bridgeville Formation is in turn overlain by

the Hood Island Formation to the south and southeast, these units having been emplaced by the Antigonish Thrust Fault. Drilling by Imperial Oil along strike near Sylvan Valley intersected >300 m of anhydrite (Ward, 1974a). The local geology is typical of the large scale solution trench valley frequently developed at the Horton/Windsor contact.



Boehner and Giles, 1982

Figure 2-7. Location and geology of the Briery Brook occurrence area. See Figures 2-1 and 2-2 for legend and location.

Recent work carried out by Nova Construction Company Limited, Inmin Resources (1986) included logs of 25 diamond-drill holes. Unfortunately none of these holes penetrated the basal carbonate making it difficult to determine the thickness of the basal sulphate at Briery Brook. Gypsum at this location was determined to consist of a wedge-shaped body. The gypsum is thickest towards the Brook to the north and thins to 10 m within 100 m to the south of the cliff faces. It can be seen in the cliff faces where it is up to 35 m high. Further information regarding the quality of the gypsum and minor anhydrite lenses is presented in Appendix 1 of Nova Construction Company Limited, Inmin Resources' (1986) report.

A conservative estimate of the reserves available at Briery Brook was given as 830 076 t (Nova Construction Company Limited, Inmin Resources, 1986). This includes an area 300 m in length parallel to the gypsum cliffs which apparently includes all of the Company's holdings at the present time. Further reserves would be expected to exist along strike away from the deposit area which has already been defined. However, due to the

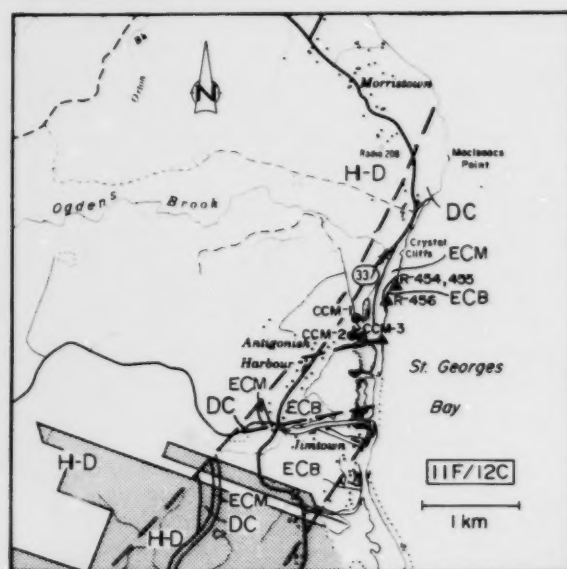
narrow configuration of the exposure of Bridgeville Formation and the wedge-shaped hydrated portion, it is believed that the tonnages available will be limited to <10 Mt. Information gathered from this area may lead to the discovery of more extensive deposits of a similar nature elsewhere in the Antigonish Basin.

CRYSTAL CLIFFS (0104)

NTS 11F/12C

UTM 585700 E 5063700 N

The Crystal Cliffs occurrence area is located 12 km north-northeast of the Town of Antigonish, Antigonish County, on the western shores of St. Georges Bay (Fig. 2-8). At one point this was the site of the Nova Scotia Centre for Geological Sciences, a field school for geology students. Subsequently the shore section found here has been the subject of numerous studies including extensive ones by Puech (1950), Sage (1954) and more recently Bochner (1980a).



Geology after Bochner and Giles, 1982

Little Narrows Gypsum (lease)

Figure 2-8. Location and geology of the Crystal Cliffs occurrence area. See Figures 2-1 and 2-2 for legend and location.

Regional geology by Bochner and Giles (1982) indicated the area is underlain by moderate to steeply dipping units of the sulphate dominated Bridgeville Formation which are in turn underlain by the Windsor Group basal carbonate Macumber Formation. The Windsor Group strata unconformably overlie Devonian-Carboniferous clastics to the west. Bochner (1980a) described this section in detail.

Although impressive when seen from a distance, the sulphates found at Crystal Cliffs consist of a long exposure of a narrow ridge of anhydrite and faulted, hydrated gypsum which is narrow in width. The anhydrite is typical of the basal sulphate, light blue in colour, fine grained with minor interstitial dark grey carbonates. The gypsum zone, which is light pink to orange in colour, appears to be a faulted, disrupted and hydrated portion of the anhydrite.

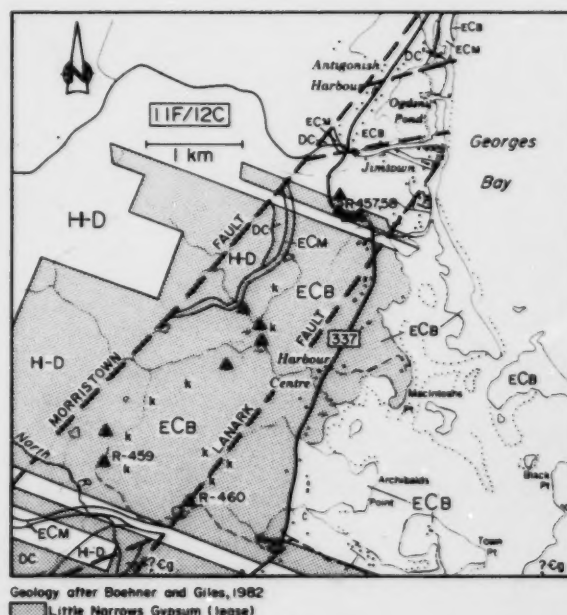
The Crystal Cliffs area has no potential for gypsum or anhydrite mining, but is of interest geologically and may possibly be of interest to sample collectors or stone carvers because of colours and varieties of gypsum.

HARBOUR CENTRE (0105)

NTS 11F/12C

UTM 584000 E 5060500 N

The Harbour Centre occurrence area is located 8 km north-northeast of the Town of Antigonish, Antigonish County, along Route 337 (Fig. 2-9). The area includes a number of surface exposures as well as karst zones between North River in the south and Jimtown to the north. Gypsum rights over much of this area are held by the Little Narrows Gypsum Co. which has, in recent years, relinquished some of these rights of the cultivated portions of the area to local farmers.



Geology after Bochner and Giles, 1982

Little Narrows Gypsum (lease)

Figure 2-9. Location and geology of the Harbour Centre occurrence area. See Figures 2-1 and 2-2 for legend and location.

Regional geological mapping by Bochner and Giles (1982) showed that this area is underlain by the sulphate dominated Bridgeville Formation. This is underlain to the north and southwest by the Macumber Formation which is in turn underlain by clastics of Devonian-Carboniferous age. It is also in fault contact with older Hadrynian to Devonian basement rocks.

Extensive well developed, karst topography can be found in this area. Numerous outcrops of high purity, white, fine grained gypsum can be seen along Route 337 and at various points in the wooded terrain to the west. Unfortunately, no diamond-drill hole information is available from this area, although Little Narrows Gypsum Company Ltd. reportedly did some drilling here in the past. As a result, the depth of hydration of the thick basal sulphate is unknown.

Should there be some portions of this area over which Little Narrows Gypsum Company Ltd. does not hold the gypsum rights, they would be ideal sites for further investigations. One negative factor in the development potential of this area would be its location. Shipments of stone from the Antigonish area would probably be made via the Strait of Canso area. This would mean the shipments would have to go first through the Town of Antigonish and then a further 50 km to the Strait area.

LANARK (0106)

NTS 11F/12C

UTM 583400 E 5056800 N

The Lanark occurrence area is located 5 km north-northeast of the Town of Antigonish, Antigonish County, along Route 337 (Fig. 2-10). It is contiguous with the Harbour Centre occurrence area to the north and the Williams Point occurrence area to the south. One drillhole, SV-74-2, was completed in this area by Imperial Oil Limited as part of a regional base metal exploration program (Ward, 1974a).

Recent geological mapping by Bochner and Giles (1982) showed this area to be underlain by the sulphate dominated Bridgeville Formation of the Windsor Group. It is in fault contact with basement rocks to the west across the Lanark Fault and is overlain by the Upper Windsor Hood Island Formation in the southern part of the area.

Numerous outcrops of fine grained, white gypsum can be seen in the area both east and west of Route 337. Extensive karst can also be seen throughout portions of the area. Anhydrite is not seen in outcrops even in the 15 m high exposures which can be seen along the shore

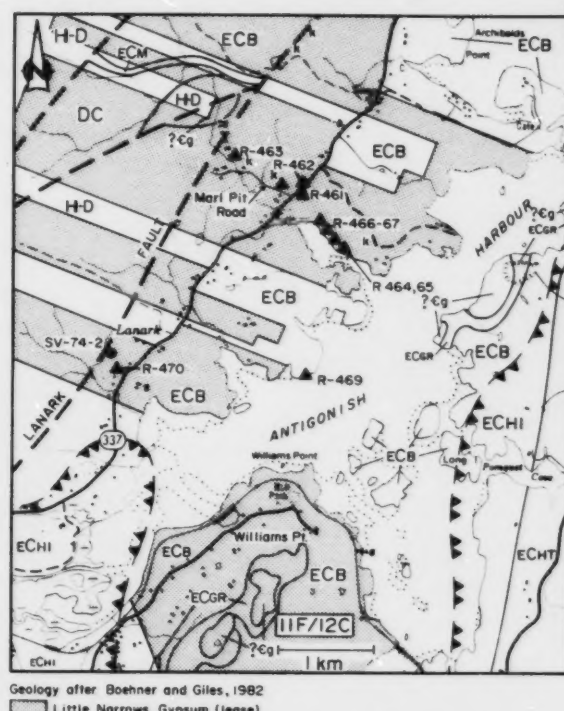


Figure 2-10. Location and geology of the Lanark occurrence area. See Figures 2-1 and 2-2 for legend and location.

of Antigonish Harbour opposite the Marl Pit Road. Information from SV-74-2, however, shows a thin hydration zone of 2 m overlying the thick basal anhydrite.

Substantial volumes of gypsum may be available in the Lanark area, but as in the Harbour Centre area, most of the gypsum rights are held by the Little Narrows Gypsum Company Ltd. This area may also have been drilled previously, however these results are not available. Further investigation of this area would be worthwhile.

MONASTERY (0108)

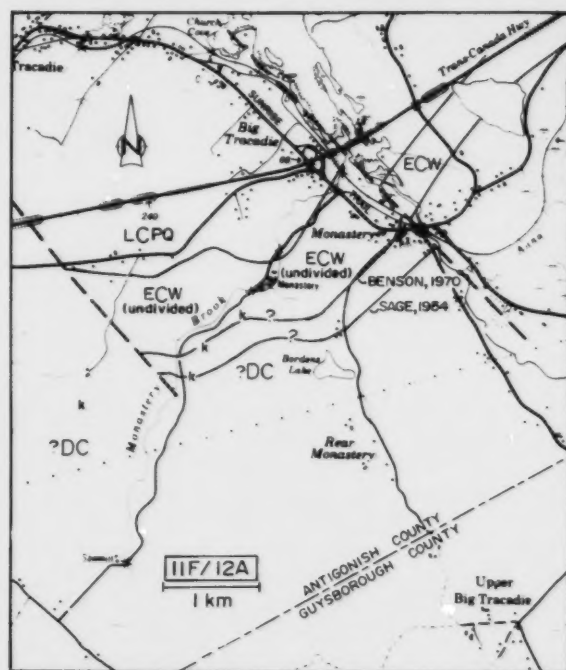
NTS 11F/12A

UTM 606500 E 5050500 N

The Monastery occurrence consists of a number of small areas of karst topography found 1-3 km southwest of the Village of Monastery, Antigonish County (Fig. 2-11). No surface exposures were located in this area and to date no diamond-drill holes have been completed in this vicinity.

Sage (1954) located a number of sinkholes south and east of Monastery Brook, but found no outcrops of gypsum or anhydrite. Schenk (1969) also mapped this

section without identifying sulphates, however Benson (1970) indicated the presence of gypsum southeast of the Monastery. None of these authors have clearly divided the Windsor Group at Monastery although Sage (1954) suggested that the A and B Subzones are present and overlies Horton Group clastics to the south and are in turn overlain by Canso Group clastics to the north.



Geology modified after Benson, 1970

Figure 2-11. Location and geology of the Monastery occurrence area. See Figures 2-1 and 2-2 for legend and location.

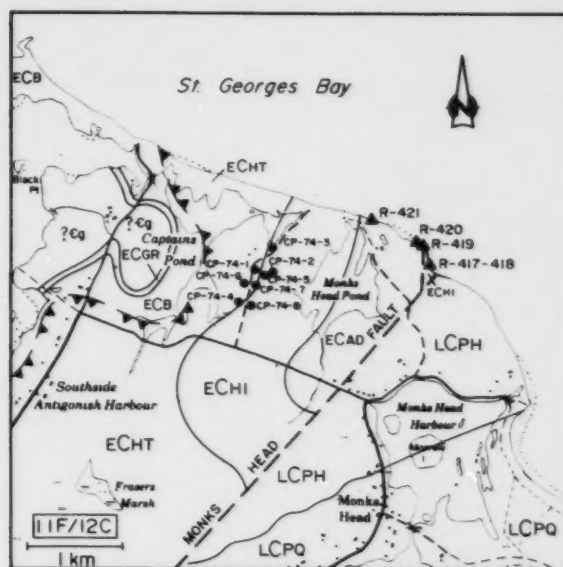
This area is of geological interest because of the presence of karst topography and possible gypsum/anhydrite in outcrop may help in determining the stratigraphy. Economic significance is only minor at this time due to the lack of areal extent of the karst. A small diamond-drill hole program in the area could help to determine the nature and extent of sulphates in the subsurface. Monastery's close proximity to the Strait of Canso, approximately 20 km to the east, would make it attractive if any volume of gypsum were found.

MONKS HEAD (0093)

NTS 11F/12C

UTM 590800 E 5058300 N

The occurrence at Monks Head is located along the shore of St. Georges Bay, 13 km northeast of the Town of Antigonish, Antigonish County (Fig. 2-12). This Windsor Group outcrop area has been the subject of



Geology after Bochner and Giles, 1982

Figure 2-12. Location and geology of the Monks Head occurrence area. See Figures 2-1 and 2-2 for legend and location.

much study and is included in works by Sage (1954) and Schenk (1969).

Recent geological mapping by Bochner and Giles (1982) determined that units of the Lower Windsor Group, Addington Formation and Upper Windsor Group Hood Island Formation are present at Monks Head. These are overlain to the west by clastics and minor carbonates of the Hastings Formation of the Canso Group and in fault contact to the east with clastics of the Port Hood Formation of the Riversdale Group (Bochner and Giles, 1982).

Sage (1954) carried out a detailed stratigraphic investigation of the Monks Head section which he described as badly faulted and "... shuffled like a pack of cards" Although numerous beds of gypsum can be seen in this section and the quality of gypsum is quite good, there is little possibility of economic exploitation.

A number of drillholes were completed to the west of this area between Captains Pond and Monks Pond by Imperial Oil Limited in 1974 as part of a regional base metal exploration program (Ward, 1974b). All of these holes were collared in the overlying Hastings or Hood Island Formations and encountered only minor gypsum or anhydrite units. None of the holes appears to have gone down into the underlying Addington Formation which contains relatively greater amounts of sulphates.

The highly faulted nature of the rocks in this area adjacent to the Monks Head Fault (Bochner and Giles, 1982) is conducive to hydration of the sulphate beds, however they do not have thickness or areal extent to permit a viable mining operation to be established here. The section is of great geological importance being one of the few good exposures of the Addington Formation readily accessible in the Antigonish Basin. This Formation is similar to those sections being exploited at Little Narrows (0087), Victoria County, and Miller Creek (0183), Hants County, and may be exploitable elsewhere in the Basin.

OHIO (0109)
NTS 11E/09A
UTM 57300 E 5040000 N

The Ohio occurrence area is located 14 km south-southwest of the Town of Antigonish, Antigonish County (Fig. 2-13). Numerous diamond-drill holes have been completed in the area by a number of companies exploring for base metals in the basal carbonates of the Windsor Group. Six of these holes encountered gypsum/anhydrite in the subsurface.

Regional geological mapping by Bochner and Giles (1982) indicated that the area is underlain by both the Bridgeville and Lakevale Formations of the Lower Windsor Group which strike north-south and dip to the east. The relationship between these Formations is complex and an explanation was presented by Giles (1980). Simplified, the Lakevale is believed to be comprised of material which infilled paleokarsted Bridgeville Formation, therefore most of the units encountered in the subsurface are predominantly clastics where the basal sulphate should have occurred. To the east these units are overridden by the Upper Windsor Hood Island Formation along the Antigonish Thrust Fault. The Lakevale Formation overlies the basal Gays River Formation and Hadrynian-Devonian basement rocks to the west.

Cuvier Mines Ltd. (Black, 1979) drilled a hole, AN-AH-3, to a depth of 305 m in the southern part of this area in 1978. Virtually the entire hole was drilled in a red or green siltstone breccia with gypsum or anhydrite cement. Similar holes were drilled by Esso Minerals Canada (MacLeod, 1980) in 1979. Two holes OH-18 and OH-23 penetrated less disturbed units of the Bridgeville Formation. However, where hydration to gypsum has extended downward, the overlying thickness of infill material increases as well.

This area is not of economic importance. Thick gypsum sections, where encountered, are covered by

thick infilled material. Geologically the area is of much interest because indurated material in paleokarst may give some clues to the timing of the hydration and dissolution of the basal anhydrite in the area (Giles, 1980).

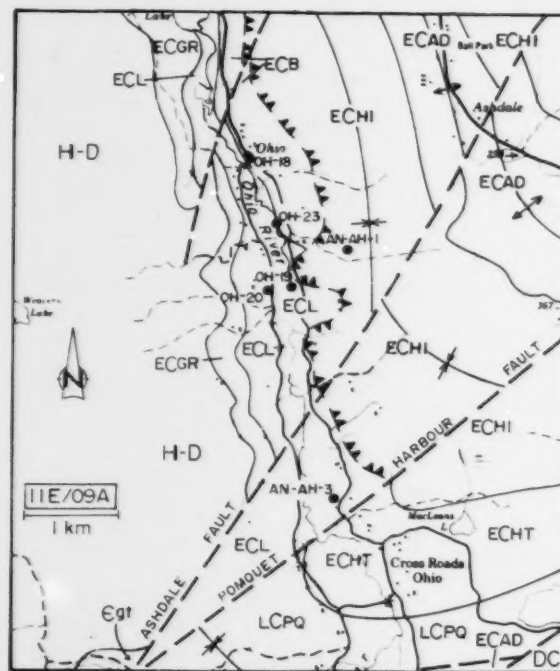


Figure 2-13. Location and geology of the Ohio occurrence area. See Figures 2-1 and 2-2 for legend and location.

POMQUET HARBOUR (0096)
NTS 11F/12C
UTM 588500 E 5054000 N

The Pomquet Harbour occurrence is a subsurface occurrence found in drillholes located just west of Pomquet Harbour 9 km east-northeast of the Town of Antigonish, Antigonish County (Fig. 2-14). A series of seven diamond-drill holes were put down in this area in 1973-74 by Imperial Oil as part of a base metal exploration program (Ward, 1974b).

Bochner and Giles (1982), in mapping the area, used the Imperial drillhole information to determine that it is underlain by a faulted sequence of Upper Windsor Group and Canso Group sedimentary rocks. Only minor amounts of gypsum were encountered in three of the drillholes which passed through portions of the Hood Island Formation (Cycles 3-5).

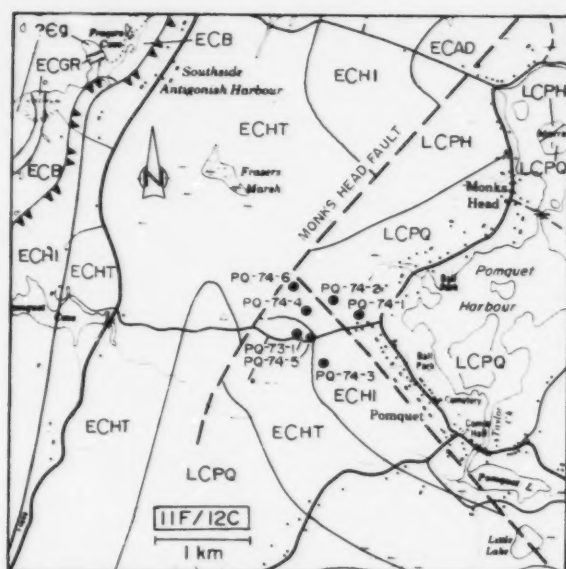


Figure 2-14. Location and geology of the Pomquet Harbour occurrence area. See Figures 2-1 and 2-2 for legend and location.

This occurrence is of no economic interest, however it serves to emphasize the structural complexity which is often encountered in the Windsor basins, particularly in their upper portions.

POMQUET RIVER (0097)
NTS 11F/12B
UTM 591600 E 5047300 N

The Pomquet River occurrence area is located 12 km east-southeast of the Town of Antigonish, Antigonish County (Fig. 2-15). It consists of several small surface outcroppings of gypsum which Boehner and Giles (1982) placed in the Hastings Formation of the Canso Group and numerous sulphate horizons encountered in three drillholes (NSDM 2554, NSDM 2555 and KEH-6).

Regional geological mapping by Boehner and Giles (1982) determined this area to be structurally complex. The clastic dominated Hood Island Formation of the Upper Windsor Group and Hastings Formation of the Canso Group underlie most of the area. Some units of the Addington Formation are also seen in drillcore in the northwestern portion of the area (Province of Nova Scotia, 1959). These units are in fault contact to the northwest and northeast with younger strata and in fault contact to the south with Devonian-Carboniferous basement rocks.

Outcrops of gypsum can be found along the Pomquet River between 2 and 3.5 km south of Highway

104. They are generally small in size with the thickest bed found 1-2 m thick. Southeast of the River a drill-hole was completed in 1966 by Kennco Explorations (KEH-6) (Grace, 1966). Boehner (1980b) interpreted this hole as having "... intersected a vertical to overturned section of the E₁ Limestone and the basal Hastings Formation". Northwest of the River two holes were drilled by Lura Corporation in 1958 (NSDM 2554 and 2555) (Province of Nova Scotia, 1959). They were drilled in units of the Addington Formation and encountered slightly more abundant sulphate horizons than hole KEH-6, however in both holes these units were probably steeply dipping and deeply buried beneath overburden or clastic sedimentary rocks.

The Pomquet River occurrence area is of geological interest only. Its structural complexity and position in the middle to upper part of the Windsor Group are unfavourable for finding economically significant sulphate bodies in the area.

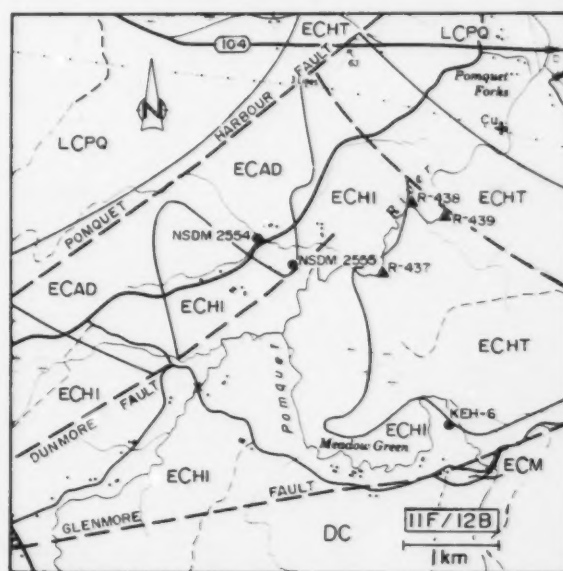
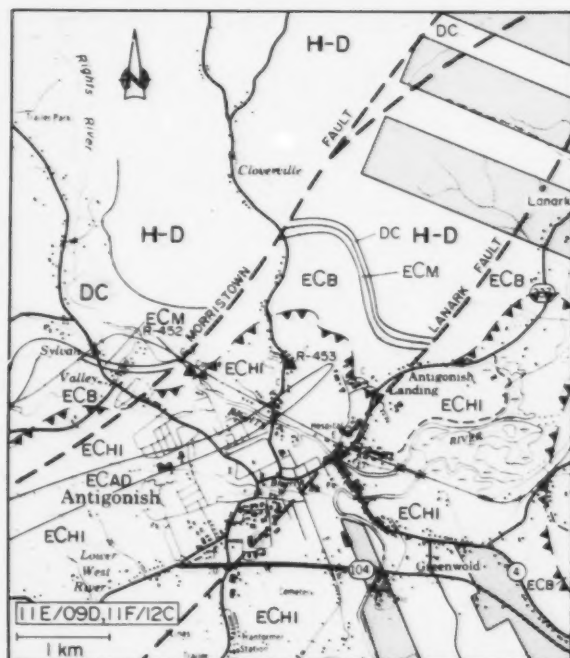


Figure 2-15. Location and geology of the Pomquet River occurrence area. See Figures 2-1 and 2-2 for legend and location.

RIGHTS RIVER (0103)
NTS 11E/09D, 11F/12C
UTM 577600 E 5053500 N

The Rights River occurrence consists of two separate outcrops both of which can be found on the northern edge of the Town of Antigonish, Antigonish County (Fig. 2-16). The first is found on the southwestern side of Rights River below the golf course and appears to

belong to the Bridgeville Formation. The second outcrop is found 750 m north of the River on the east of a secondary highway which is known locally as Fairmont Road or Cloverville Road. It is believed to be a minor interbed which belongs to the Hood Island Formation (Sage, 1954).



Geology after Boehner and Giles, 1982
 Little Narrows Gypsum (lease)

Figure 2-16. Location and geology of the Rights River occurrence area. See Figures 2-1 and 2-2 for legend and location.

Regional geological mapping by Boehner and Giles (1982) included both outcrop areas in a fault-bound block bounded to the northwest by the Morristown Fault and to the southeast by the Lanark Fault. The outcrop of the Bridgeville Formation consists of a head up to 7 m high and 15 m long of fine grained, white gypsum with minor interstitial carbonate material.

The outcrop located 750 m north of Rights River is a 2.5 m thick selenitic gypsum interbed in a section dominated by dark red siltstones. This section was described in some detail by Sage (1954) as the Milk Plant section. In general the entire section here consists of the uppermost Hood Island Formation of the Upper Windsor Group which is thrust up over the Lower Windsor Group sulphate dominated Bridgeville Formation. This is in turn underlain by the basal Windsor Macumber Formation and Devono-Carboniferous clastics. This section trends northwest-

ward and is cut off by the Morristown and Lanark Faults to the west and east respectively.

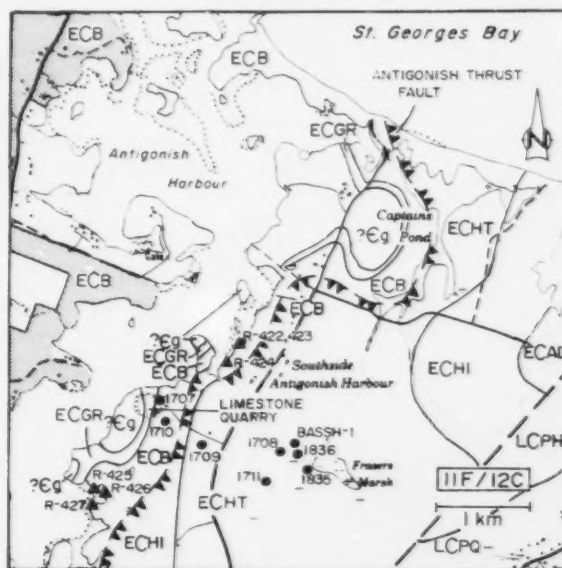
The occurrences in this area are strictly of geological interest. Even if sufficient volumes of material were present south of the Rights River, its location at the edge of Antigonish would preclude any development.

SOUTHSIDE ANTIGONISH HARBOUR (0094)

NTS 11F/12C

UTM 585700 E 5056300 N

The Southside Antigonish Harbour occurrence is located 8 km northeast of the Town of Antigonish, Antigonish County (Fig. 2-17). Several outcrops of gypsum and anhydrite can be seen along the eastern side of Antigonish Harbour both north and south of Ridge Brokers Limited's limestone quarry. Drilling information from this area has been the subject of investigations by Sage (1954), Boehner (1986) as well as numerous undergraduate studies by geology students from St. Francis Xavier University, Antigonish.



Geology after Boehner and Giles, 1982
 Little Narrows Gypsum (lease)

Figure 2-17. Location and geology of the Southside Antigonish Harbour occurrence area. See Figures 2-1 and 2-2 for legend and location.

Regional geological mapping by Boehner and Giles (1982) indicated that an undisturbed sequence of basal carbonate, and sulphate overlying a Carboniferous or older granitic body to the west, occurs along the eastern shore of Antigonish Harbour. However, immediately to the east, this sequence is covered by units of Hood

Island and Hastings Formations which have been thrust over top of the A Subzone Bridgeville (basal anhydrite) and Gays River Formations. A series of seven drillholes (Fig. 2-17), by the Nova Scotia Department of Mines in 1951 and 1952 as part of a salt exploration program (Nova Scotia Department of Trade and Industry, 1952), as well as one oil well drilled in 1976 by the Bras d'Or Oil Company (Farries Engineering Limited, 1976) provide stratigraphic information east of the outcrop areas.

In outcrop, the sulphate units of the Bridgeville Formation are nodular to massive, high purity gypsum with minor limestone interlaminae; locally northeasterly striking and vertical joints are prominent. The few drillholes put down near these exposures indicate hydration to depths >30 m below surface. Karst topography in the area also suggests that gypsum is present below the surface in the immediate area.

The Southside Antigonish Harbour area would be a good location for a small drilling program to test the depth of hydration of the Bridgeville Formation sulphates and might possibly support a small gypsum mining operation. The limited outcrop area of these units would probably prevent any significant developments. The other negative factor in this area is the substantial distance to the nearest ocean shipping point (Strait of Canso), approximately 40 km to the east.

SYLVAN VALLEY (0102)

NTS 11E/09D

UTM 576100 E 5053100 N

The Sylvan Valley occurrence area is located 1 km northwest of the Town of Antigonish, Antigonish County (Fig. 2-18). The occurrence consists of two outcrop areas, a small area of karst topography, and sulphate horizons encountered by drillholes completed by Imperial Oil in 1973-74 as part of a regional base metal exploration program (Ward, 1974a; Burton, 1974a).

Geological mapping by Bochner and Giles (1982) indicated that this area is underlain by the sulphate dominated Lower Windsor Group Bridgeville Formation. This is underlain to the north and west by the basal Macumber Formation and in turn Devonian-Carboniferous clastics. As at Brierly Brook (0101), the Bridgeville is overlain to the south by Upper Windsor Hood Island Formation which overrides the Bridgeville along the Antigonish Thrust Fault. This section is slightly offset by another fault to the east.

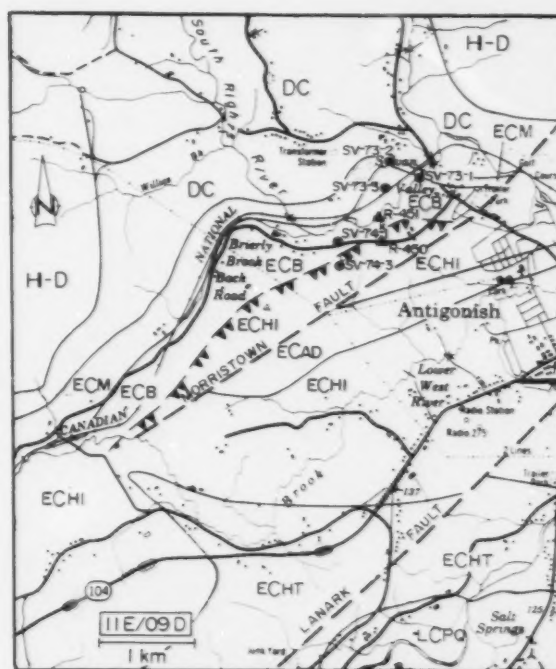


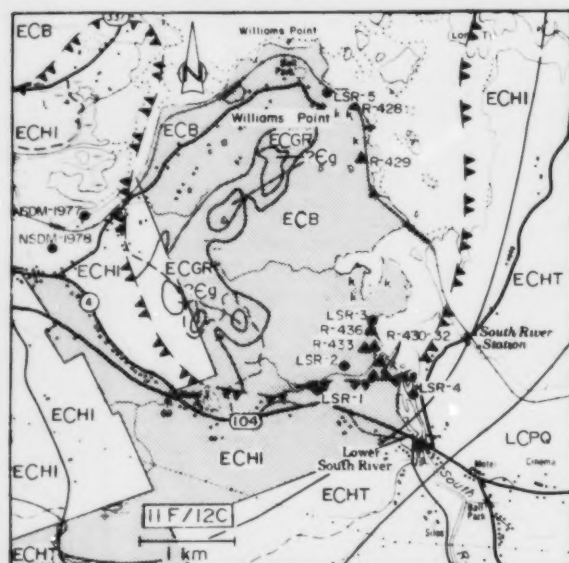
Figure 2-18. Location and geology of the Sylvan Valley occurrence area. See Figures 2-1 and 2-2 for legend and location.

Imperial Oil Limited drilled a total of five diamond-drill holes in this area in 1973 and 1974. Three of these encountered the basal sulphate and four of the five passed through the basal Macumber limestone before entering the underlying Devonian-Carboniferous conglomerates. Hole SV-74-3 is believed to have passed through 17.2 m of evaporites with minor carbonates before entering the Macumber Formation; it represents the thickest evaporite section encountered (Burton, 1974a). However, it is found beneath a section of clastics of the Hood Island Formation. In the two other holes (SV-73-2 and SV-74-1) which collared in the basal anhydrite, a maximum surface hydration of 5.4 m was seen in SV-74-1. Although some deeper hydration is inferred by karst topography found just south of the South Rights River in this area, there does not appear to be as thick a hydrated section as is seen at Brierly Brook (0101).

The Sylvan Valley area does not appear to have much economic potential. The thick gypsum section seen at Brierly Brook is not apparent in this area and the proximity of the Town of Antigonish would prohibit development even if significant gypsum were present.

WILLIAMS POINT (0095)
 NTS 11F/12C
 UTM 583900 E 5053400 N

The Williams Point occurrence area is located 4 km east of the Town of Antigonish, Antigonish County (Fig. 2-19). It encompasses all gypsum and anhydrite found at the surface and in numerous drillholes from Williams Point in the north to Highway 104 in the south, from South River in the east to West River in the west.



Geology: after Boehner and Giles, 1982
 Little Narrows Gypsum (lease)

Figure 2-19. Location and geology of the Williams Point occurrence area. See Figures 2-1 and 2-2 for legend and location.

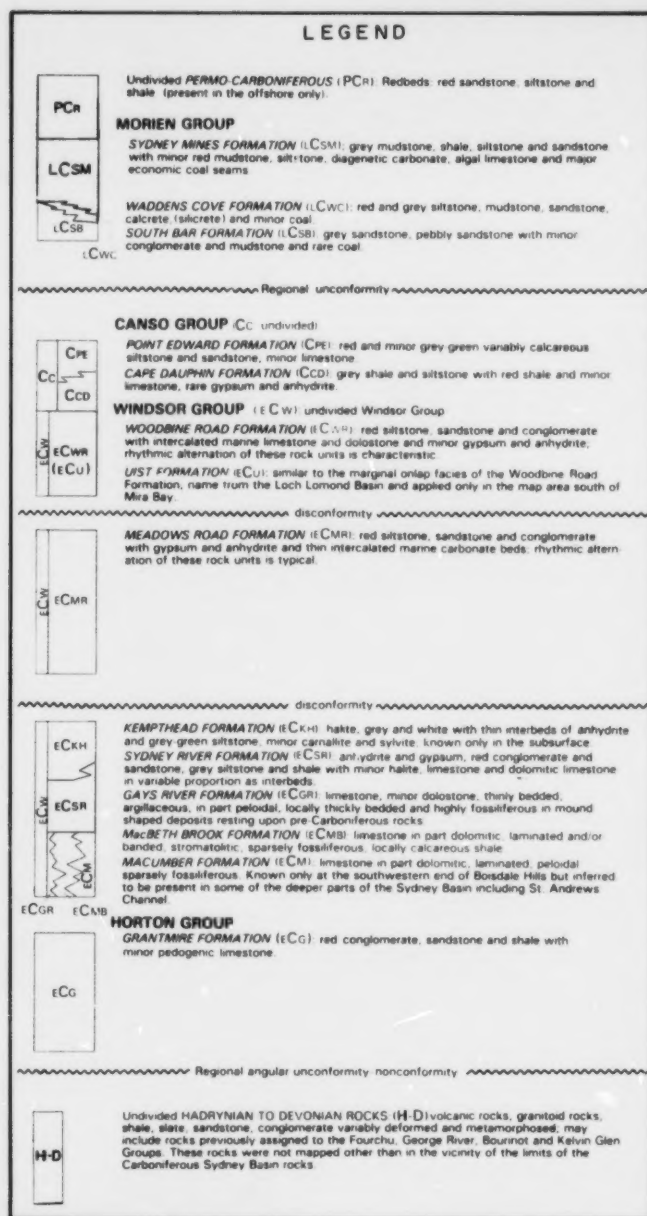
Boehner and Giles (1982) mapped this area as part of their Antigonish Basin map sheet. The Williams Point area is underlain by a north-northeasterly trending ridge of granitic rocks of undetermined age. These are overlain for the most part by carbonates identified by Sage (1954) as belonging to the Cycle 2 (B Subzone) of the Windsor Group. Boehner and Giles (1982), using

drillhole and field data and information from similar units seen in the Shubenacadie Basin, determined that these units belonged to the Gays River Formation of the Cycle 1 (A Subzone) rather than the B Subzone. The carbonate units are in turn overlain to the west, north and east by the thick sulphate units of the Cycle 1 (A Subzone) Bridgeville Formation. All of these units are overlain to the west, south and east by the clastics and interbedded carbonates of the Upper Windsor Hood Island Formation which are believed to have been thrust up over them by the Antigonish Thrust Fault (Boehner, personal communication).

Between 1976 and 1978 U.S. Borax drilled five holes in the Williams Point area as part of a base metal exploration program (Burton, 1977). Three of these holes (LSR-2, -3 and -5) were collared in the A Subzone and were stopped in the underlying basement. They are all located on the eastern side of the basement ridge and indicate a rather gentle dip of $<10^\circ$ into the Antigonish Basin in this area. Hole LSR-4 may have been collared in the Bridgeville or overthrust Hood Island Formation and encountered mainly anhydrite before entering granite at 165.8 m. LSR-1 appears to have been started in the Hood Island Formation, entered the Bridgeville Formation at 54.4 m and stopped in basement at 212.8 m. All of these holes showed some hydration of the uppermost portion of the basal sulphate and abundant heads in the area exhibit good hydration near surface.

The limited drillhole information and extensive karst topography and outcrop seen in the Williams Point area provide insufficient information to evaluate its potential gypsum/anhydrite resources. This information does suggest that this area would benefit from further investigation. Although hydration is generally thin (maximum 15.2 m in LSR-5) there is quite a large area underlain by the Bridgeville Formation. King (1985) reported that gypsum rights for this entire area are held by the Little Narrows Gypsum Company Ltd. and this fact would hinder any others from carrying out any further investigations.

CHAPTER 3. CAPE BRETON COUNTY



after Boehner and Giles, 1986

Figure 3-1. Geological legend for Cape Breton County gypsum and anhydrite occurrence maps.

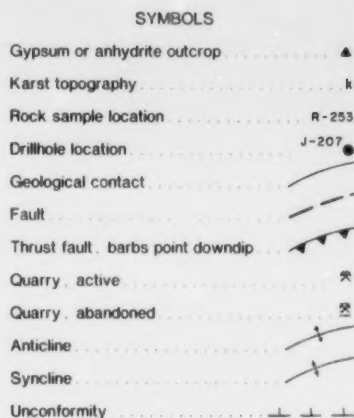


Figure 3-1. Continued.

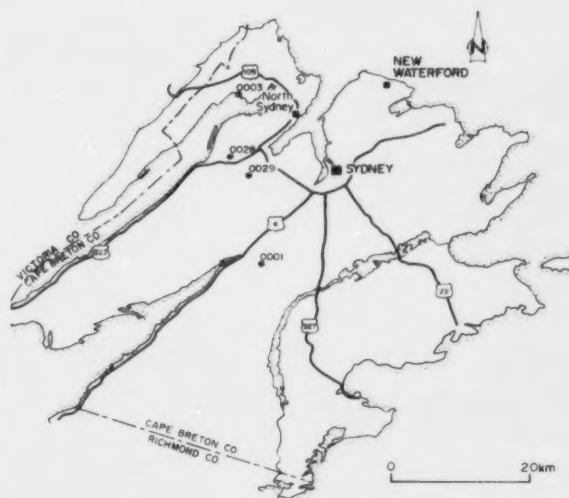


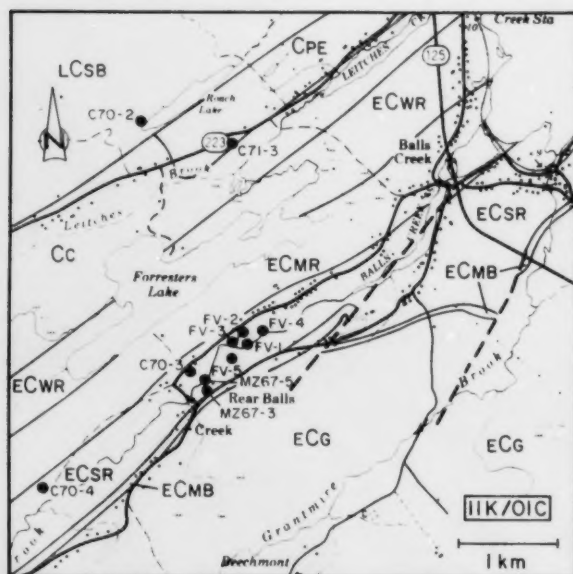
Figure 3-2. Location map for Cape Breton County gypsum and anhydrite occurrences by reference number.

REAR BALLS CREEK (0029)

NTS 11K/01C

UTM 705600 E 5112230 N

Located 9 km southwest of North Sydney, Cape Breton County, the Rear Balls Creek area was the subject of base metal and celestite exploration during the late 1960s and early 1970s (Fig. 3-6). Although no surface evidence of gypsum or anhydrite is known here, eight different drillholes have encountered gypsum, anhydrite or both in the subsurface (Oldale, 1967; Cerro Mining Co., 1972; Forgeron, 1974).



Geology after Boehner and Giles, 1986

Figure 3-6. Location and geology of the Rear Balls Creek occurrence area. See Figures 3-1 and 3-2 for legend and location.

Regional geological mapping by Boehner and Giles (1986) showed this area as being underlain by interbedded evaporites, clastics and carbonates of the Sydney River Formation which strike northeastward and dip to the west. These units are overlain by similar interbedded Windsor Group units to the northwest and are underlain by Horton Group clastics to the southeast.

Although some gypsum horizons attain thicknesses of 12 m or more in this area, the fact that they are underground and dipping 10-45° makes them of little economic interest.

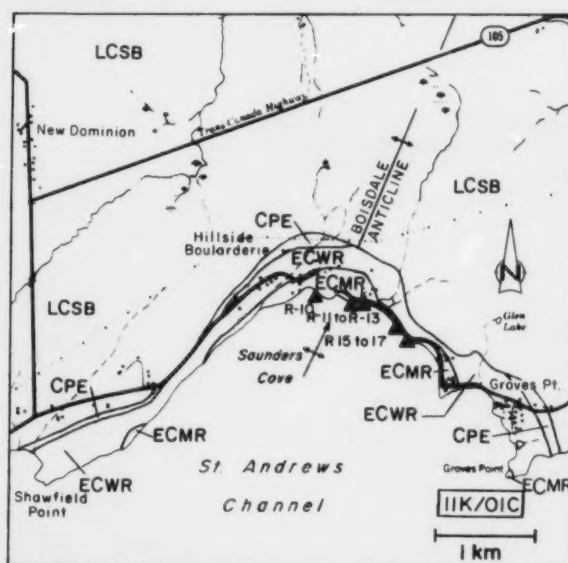
SAUNDERS COVE (0003)

NTS 11K/01C

UTM 703000 E 5124000 N

Located in Hillside Boularderie 7 km west of Bras d'Or, Cape Breton County, Saunders Cove lies on the northern side of St. Andrews Channel (Fig. 3-7). A sequence of interbedded gypsum, limestone and siltstone is found along the shore which Boehner and Giles (1986) placed in the Meadows Road Formation. The largest of the gypsum outcrops are found near the crest of the Boisdale Anticline and therefore the strata dip both to east and west at this point. Minor karst can be seen inland from these outcrops, however it is not very extensive.

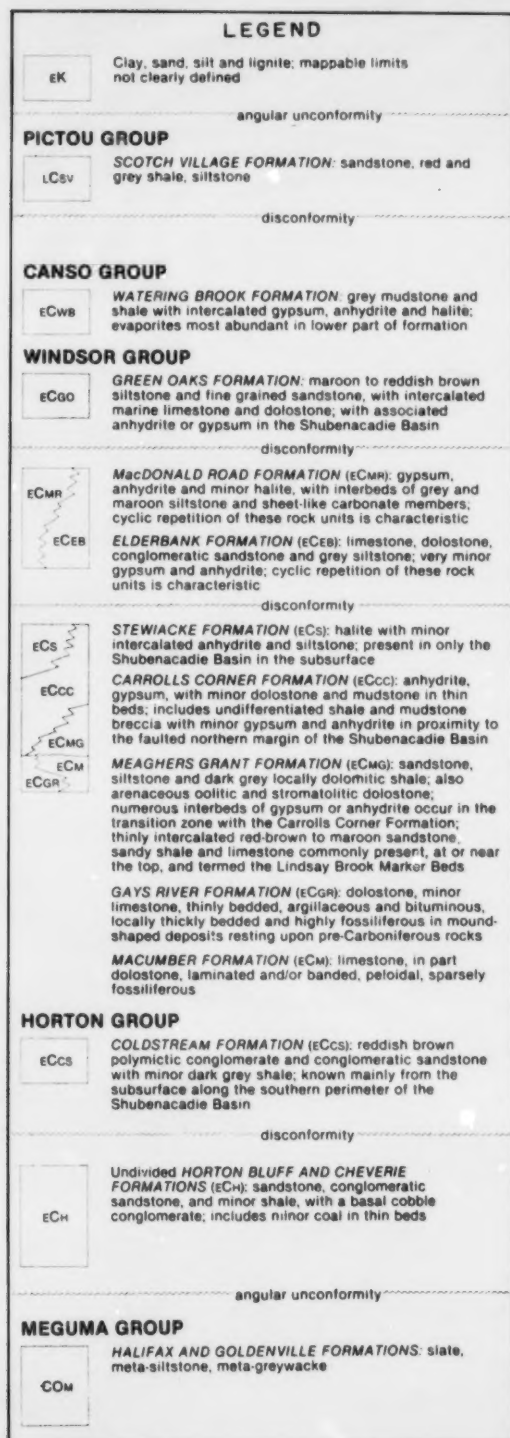
Due to its limited areal extent, this occurrence is not of economic interest.



Geology after Boehner and Giles, 1986

Figure 3-7. Location and geology of the Saunders Cove occurrence area. See Figures 3-1 and 3-2 for legend and location.

CHAPTER 4. COLCHESTER COUNTY



After Giles and Bochner, 1982

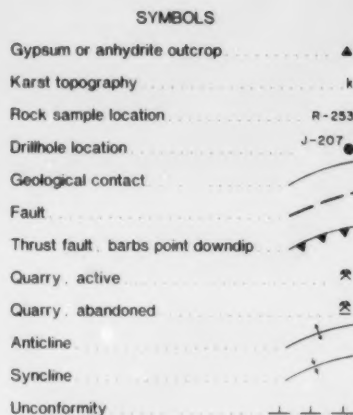


Figure 4-1. Continued.

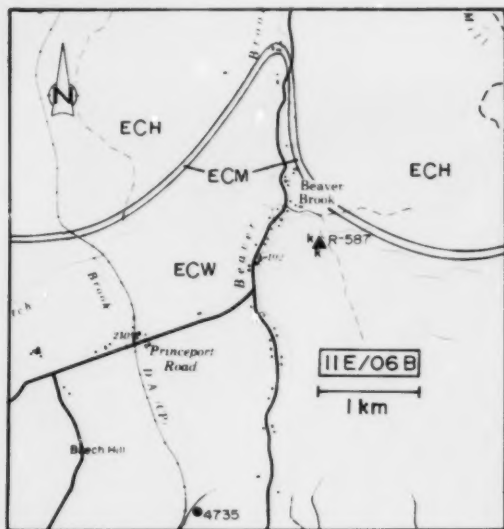


Figure 4-2. Location map for Colchester County gypsum and anhydrite occurrences by reference number.

Figure 4-1. Geological legend for Colchester County gypsum and anhydrite occurrence maps.

BEAVER BROOK (0148)
 NTS 11E/06B
 UTM 467500 E 5017100 N

The Beaver Brook occurrence area is located 10 km west-southwest of the Town of Truro, Colchester County (Fig. 4-3). It consists of 0.5 ha of moderate to heavy karst topography with a few small rounded heads of white to light blue-grey, fine grained, massive, partially hydrated anhydrite.



Geology after Stevenson, 1958

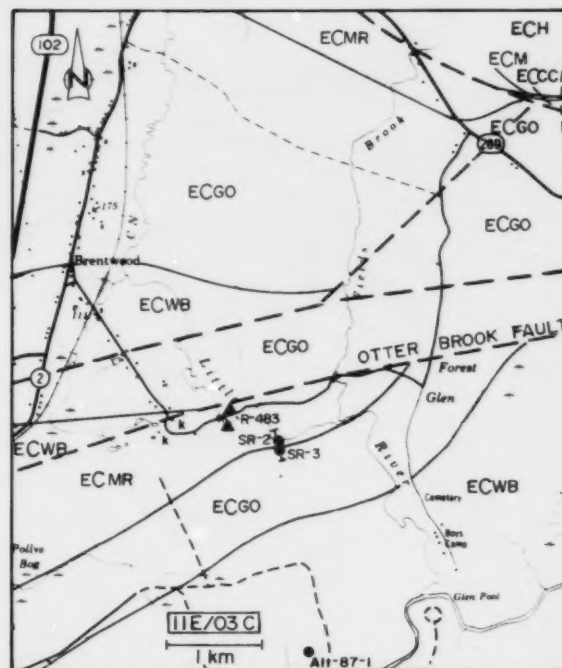
Figure 4-3. Location and geology of the Beaver Brook occurrence area. See Figures 4-1 and 4-2 for legend and location.

Regional geological mapping by Stevenson (1958) showed this area as underlain by units of the Lower Windsor Group near the contact with the underlying Horton Group. Outcrops of the basal Windsor Macumber Formation carbonate are known in this area and subsequently it was the subject of a small drilling program in 1988 carried out by Lafarge Canada (Canada Cement Lafarge Ltd., 1988). Although limited in its scope, this work indicated that the geology of the area is structurally complex. None of the Lafarge holes passed through any portion of the Carrolls Corner Formation sulphates.

The Beaver Brook area is structurally complex and the lack of hydration in the small exposures indicate development possibilities are limited. Should additional drilling be carried out in this area for limestone resources, then stepout holes could add to the limited information presently available.

BRENTWOOD (0120)
 NTS 11E/03C
 UTM 478900 E 5006000 N

The Brentwood occurrence area is located south and west of Little River, 5 km south of the Town of Brookfield, Colchester County (Fig. 4-4). The occurrence consists of several small outcrops of light grey to white, fine grained gypsum with minor interstitial silt which can be found along the Little River, a small area of karst topography south of the River and gypsum and anhydrite units intersected in two diamond-drill holes.



Geology after Giles and Boehner, 1982

Figure 4-4. Location and geology of the Brentwood occurrence area. See Figures 4-1 and 4-2 for legend and location.

Recent geological mapping by Giles and Boehner (1982) indicated that the immediate area is underlain by interbedded carbonates, clastics and sulphates of the MacDonald Road and Green Oaks Formations of the Windsor Group as well as similar lithologies of the Watering Brook Formation of the Canso Group. These units strike northeast-southwest through the area and dip southward into the Stewiacke Syncline. They are also in fault contact with similar units to the north along the Otter Brook Fault. Two diamond-drill holes (SR-2, SR-3) were completed in this area by Aurum Gold Mines Ltd. (1973) as part of a base metal exploration program. Considerable sections of gypsum and anhy-

drite of varying purities were encountered in both drill-holes. The sulphate horizons are interbedded with siltstones and dolomite carbonates. The gypsum beds are described as varying from light grey and pure to dark grey selenitic with lenses of siltstone (Aurum Gold Mines Ltd., 1973).

More recently, Nova Scotia Department of Mines and Energy hole Alt-87-1 was put down in the area 2000 m south of Aurum's drillholes. Carter (1988) gave a detailed description of the core and stratigraphic interpretation of the section encountered. The hole, collared in the Watering Brook Formation of the Canso Group, was stopped due to technical problems (natural gas flow) at 683.05 m in the Carrolls Corner Formation.

Hole SR-2 stopped at 147.83 m in gypsum after passing through a section dominated by gypsum with minor clastic and carbonate interbeds (Aurum Gold Mines Ltd., 1973). Although no information regarding the quality of gypsum is available, the section looks very promising. Unfortunately the areal extent of the MacDonald Road Formation in this area is quite restricted, cut off to the north by faulting and dipping underneath the clastic dominated Green Oaks Formation to the south. In addition, this area is becoming developed as a rural subdivision which would prevent any potential development. Finally the area is quite distant from any possible shipping sites which would also restrict site development.

Geologically the area is interesting; the section appears to be similar to the Cycle 2 (B Subzone) sections mined elsewhere in the Province. There would appear to be little development potential.

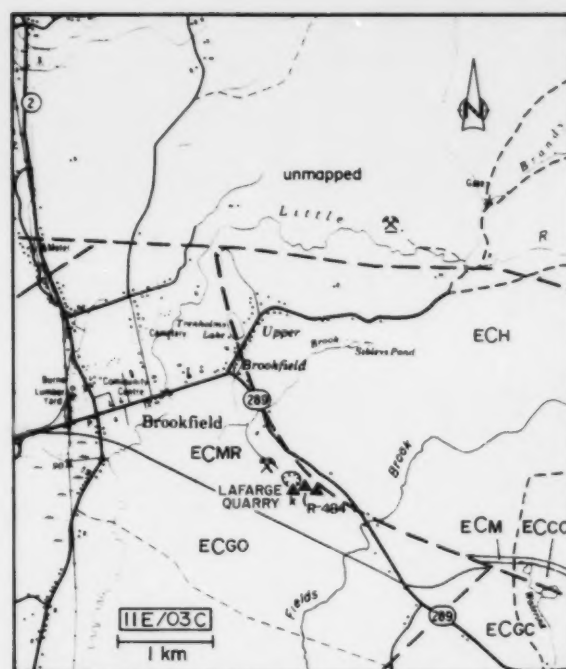
BROOKFIELD (0121)

NTS 11E/03C

UTM 479800 E 5010400 N

The Brookfield occurrence is located 2 km southeast of the Village of Brookfield, Colchester County (Fig. 4-5). A small quarry has been developed at this site (just southwest of Route 289) by Lafarge Canada Inc. to supply its cement plant west of Brookfield. Production has been reported for 1984 and 1985 when a total of 14 744 t of gypsum were extracted and trucked 7 km to its plant.

Regional geological mapping by Giles and Bochner (1982) interpreted the rocks underlying this area as belonging to Cycle 2 (B Subzone) MacDonald Road Formation of the Windsor Group. The units strike northwest-southeast through the area and dip under-



Geology after Giles and Bochner, 1982

Figure 4-5. Location and geology of the Brookfield occurrence area. See Figures 4-1 and 4-2 for legend and location.

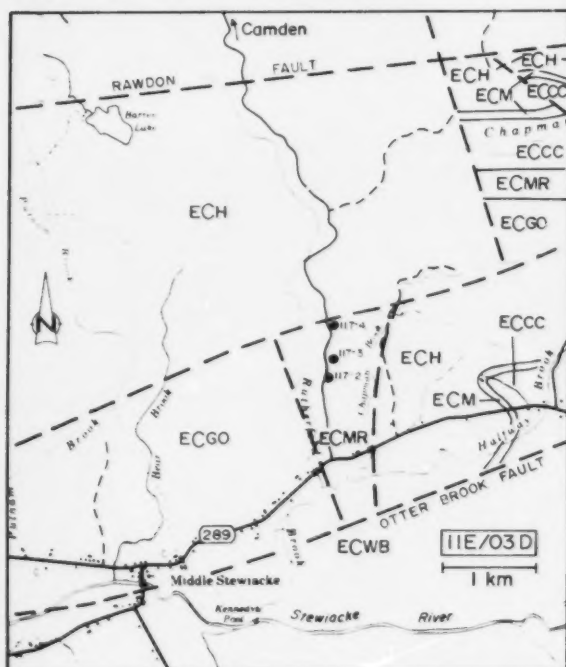
neath clastics and carbonate horizons of the Green Oaks Formation to the south and west. These units are also in fault contact with Horton Group clastics to the north and east.

Lafarge has drilled a number of shallow diamond-drill holes in the vicinity of its quarry, eight of which (86-02 to 86-09 inclusive) are presently stored at the Nova Scotia Department of Mines and Energy, Core Library in Stellarton. Variably silty, selenitic gypsum horizons which are up to 21.3 m thick (drilled thickness) were found to be interbedded with clastics and carbonates. Moderate to heavy karst topography with rounded gypsum outcrops extend along strike southeast for approximately 500 m. Insufficient information is available to carry out detailed stratigraphic correlation of the units, however beds appear to dip at roughly 40-45° to the south.

The limited areal extent of the MacDonald Road Formation, as well as the proximity of Route 289 which passes through the area limit the potential for large scale development at this site. Lafarge may continue to exploit this deposit, however it is unlikely that any large scale quarrying will be possible.

CAMDEN ROAD (0153)
 NTS 11E/03D
 UTM 491200 E 5010020 N

The Camden Road occurrence area is located 13 km east of the Village of Brookfield, Colchester County (Fig. 4-6). It consists of subsurface intersections of gypsum and anhydrite in three drillholes put down in 1974 by St. Joseph Explorations Ltd. (Jowett, 1974).



Geology after Giles and Boegner, 1982

Figure 4-6. Location and geology of the Camden Road occurrence area. See Figures 4-1 and 4-2 for legend and location.

Regional geological mapping by Giles and Boegner (1982) indicated that this locale is underlain by a fault-bound block of interbedded sulphates, carbonates and clastics of the MacDonald Road Formation. This is bound to the north and east by Horton Group clastics, to the west by the overlying Green Oaks Formation and to the south by units of the Watering Brook Formation. This block is only 2000 m north-south by 300-1300 m east-west and straddles the southern end of the Camden Road where it joins Route 289.

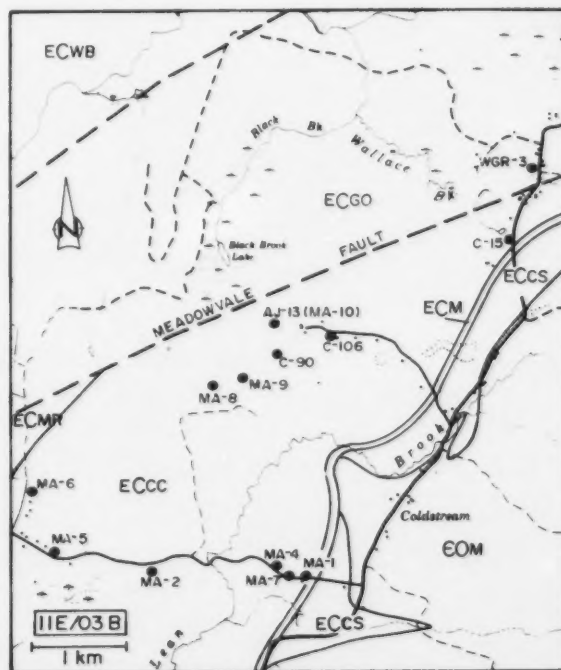
St. Joseph Explorations drilled three holes in this area in 1974 as part of a regional base metal exploration program (Jowett, 1974). All three appear to have been collared near the base of the MacDonald Road Formation and were stopped near the top of the Stewiacke Formation in salt. Although closely spaced,

correlation of these three holes is very tenuous which suggests that the area is structurally complex. One hole (117-2) was relogged by Nova Scotia Department of Mines and Energy staff after it was logged by St. Joseph's staff and units that they originally described as gypsum below 100 m were relogged as anhydrite (Boegner, personal communication). Bearing this in mind, hydration in the Camden Road area extends to at least 100 m below surface. Unfortunately overburden and interbedded horizons overlie thick sulphate horizons in all three holes to a depth of at least 39.6 m.

The Camden Road area occurrence is of geological interest only. The deeply buried sulphate horizons as well as the uncertain depth of hydration result in very poor potential for development.

COLDSTREAM (0124)
 NTS 11E/03B
 UTM 472000 E 4991000 N

The Coldstream occurrence area is located 5 km east of the Village of Shubenacadie, Hants County (Fig. 4-7). It is defined in numerous drillhole intersections through the sulphate-dominated Cycle 1 (A Subzone) Carrolls Corner Formation which underlies much of the area. This area abuts the Pine Grove occurrence area (0123) to the south.



Geology after Giles and Boegner, 1982

Figure 4-7. Location and geology of the Coldstream occurrence area. See Figures 4-1 and 4-2 for legend and location.

Regional geological mapping by Giles and Boehner (1982) indicated that much of this area is underlain by the Carrolls Corner Formation which strikes northeast and dips to the west into the Shubenacadie Basin. The anhydrite of the Carrolls Corner Formation is underlain by the Macumber Formation to the east and is overlain to the west by the mixed and interbedded sulphates, carbonates and clastics of the MacDonald Road Formation. A major fault along the northern end of the area brings the Upper Windsor Green Oaks Formation into contact with the Carrolls Corner Formation in this area.

A total of 13 diamond-drill holes were found which have intersected portions of the Windsor Group in this area. Amax Exploration Inc. (1974b) and Imperial Oil Ltd. and Jorex Ltd. (Johnston, 1973a), all drilled base metal exploration holes in the area during the early 1970s. All but one hole was collared in the A Subzone, 10 of 13 penetrated to the underlying Horton Group clastics. One hole, drilled by Dresser Minerals (WGR-3) collared beyond the fault to the north encountered interbedded clastics, carbonates and minor sulphates of the Upper Windsor (Boehner, personal communication). Unusually, no surface exposures and only minor hummocky terrain, which might reflect underlying karst features, were found in this area.

Virtually all of the drillholes in this area encountered thin surface hydration of the thick basal sulphate unit. As is seen elsewhere along this same margin of the Shubenacadie Basin, thicker sections of anhydrite are found towards the contact with the overlying MacDonald Road Formation. The best interval is noted in hole MA-6 where 54.9 m of dark grey, selenitic gypsum, with the minor siltstone and carbonate interbeds, is overlain by 17.7 m of overburden (Johnston, 1973a).

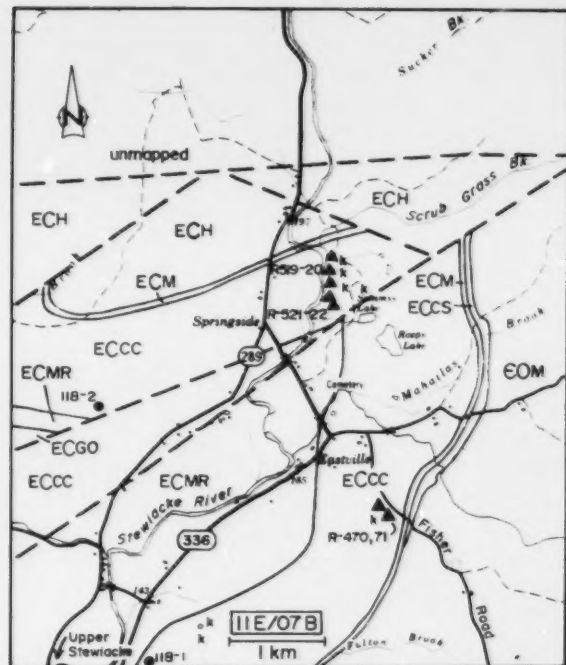
The Coldstream area has good potential for significant volumes of gypsum, similar to that mined at East Milford. It will require additional drillhole information to evaluate its potential. The lack of surface exposures and well developed karst topography should not detract from the area's appeal as an exploration target.

EASTVILLE (0115)

NTS 11E/07C

UTM 509500 E 5014500 N

The occurrence at Eastville consists of three separate areas of karst topography and outcrops located 10 km northeast of the Village of Upper Stewiacke, Colchester County (Fig. 4-8). In addition two drillholes through the same stratigraphic horizon are found within the Eastville area, although neither is located very near the surface showings.



Geology modified after Giles and Boehner, 1982

Figure 4-8. Location and geology of the Eastville occurrence area. See Figures 4-1 and 4-2 for legend and location.

Regional geological mapping by Giles and Boehner (1982) showed this area to be cut by several faults. Two of the surficial occurrences in the area are underlain by the Cycle 1 (A Subzone) sulphate dominated Carrolls Corner Formation. The third area which consists of karst is underlain by the MacDonald Road Formation which overlies the Carrolls Corner Formation. The Carrolls Corner Formation is underlain by the basal Windsor Group Gays River Formation or equivalent Macumber Formation. These are underlain by clastics of the Coldstream Formation of the Horton Group and metamorphic rocks of the Cambro-Ordovician Meguma Group.

The most widespread area of karst and outcrop of gypsum and anhydrite in the Eastville area is found east of the Stewiacke River and south of Scrub Grass Brook. Approximately 50 ha of heavy karst can be seen here accompanied by abundant heads and extensive outcrops of fine grained, white gypsum over light blue-grey anhydrite. Small borate nodules are common in the anhydrite. A second area of karst topography and outcrop can be found south 2 km, just west of Fisher Road. Karst is less extensive than the area to the north and outcrops here are generally small, rounded exposures of fine grained, light grey, mixed gypsum and anhydrite. The third area in the Eastville occurrence consists of a

number of sink holes located 500 m east of Route 336 and 1500 m north of Fulton Brook. Approximately 20 ha of karst topography can be seen on airphotos of this area.

Two diamond-drill holes (118-1 and 118-2) were completed in the Eastville area by St. Joseph Explorations in 1974 as part of a regional base metal exploration program (Jowett, 1974). Both holes appear to have been collared and stopped within the basal sulphate of the Carrolls Corner Formation. Although hole 118-2 encountered a dissolution zone at depth, both holes encountered thin hydration zones overlying thick anhydrite units. Hole 118-1, located near the area of karst north of Fulton Brook, encountered only 6 m of overburden followed by 6 m of gypsum before entering thick anhydrite.

All three separate occurrences within the Eastville area warrant additional investigation. Although hydration zones appear to be quite thin, large areas of karst topography indicate shallow overburden underlain by gypsum over considerable areas. The nearest shipping access for this area would be the new facility at Sheet Harbour, approximately 65 km to the southeast.

GLENBERVIE (0116)

NTS 11E/07B

UTM 504840 E 5007350 N

The Glenbervie occurrence area is located 8 km north-east of the Village of Upper Stewiacke, Colchester County (Fig. 4-9). It is comprised of one surface exposure as well as numerous drillholes which encountered gypsum or anhydrite in the subsurface.

Regional geological mapping by Giles and Bochner (1982) suggested that the area is cut by numerous faults. A small lead showing in the area has resulted in a large number of drillholes being put down by exploration companies over the years. Data from these holes were used by Giles and Bochner (1982) in their interpretation of the local geology.

Two separate blocks of sulphate dominated Windsor Group strata are present in the Glenbervie occurrence area. In both cases, the sulphate dominated Carrolls Corner Formation is overlain by the interbedded carbonates, clastics and sulphates of the MacDonald Road Formation. One block is in fault contact with clastics of the Horton Group to the north, east and west. The other area is underlain to the northeast by the basal carbonate of the Windsor Group (Macumber Formation) which is underlain by the clastics of the Horton Group, and overlain to the southwest by units of the Upper

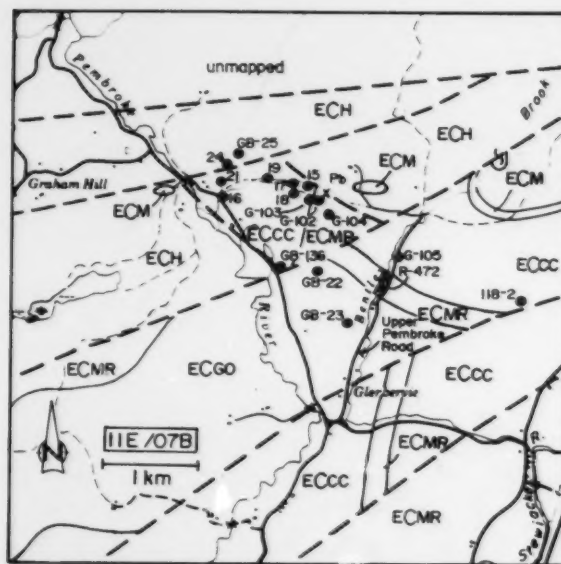


Figure 4-9. Location and geology of the Glenbervie occurrence area. See Figures 4-1 and 4-2 for legend and location.

Windsor Group Green Oaks Formation (Giles and Bochner, 1982).

The surface exposure can be found along the western side of Bentley Brook, 1300 m north on the Upper Pembroke Road. It consists of several 10 m high, fine grained, gypsum outcrops, spread out along a 100 m long ridge running north-south along the Brook. The gypsum contains minor amounts of dark grey, shaly silt. Hole G-105, drilled 300 m further north, encountered 14.6 m of overburden, 3.4 m of limestone, 2.4 m white gypsum and 12.8 m of anhydrite before it was stopped (MacLeod, 1978). This occurrence is probably located near the base of the MacDonald Road Formation or the top of the Carrolls Corner Formation.

One kilometre to the northwest, in the vicinity of the lead showing, numerous drillholes have also encountered sulphates. Much of this area is covered by thick overburden and thick sections of solution fill material. The block is bound on four sides by faults (Giles and Bochner, 1982) which probably facilitated deep hydration and later dissolution of the gypsum. In general, only a thin gypsum horizon remains over the thick basal anhydrite and, in most cases, this is overlain by thick carbonate or overburden.

The Glenbervie occurrence is of little economic interest, dissolution having apparently removed whatever good gypsum sections may have been present in the area.

The highly faulted nature of the geology in this area probably made hydration of the basal anhydrite easier, but it also permitted dissolution of the gypsum which allowed later infilling by clastic materials.

HILDEN (0149)

NTS 11E/06B

UTM 473900 E 5017400 N

The Hilden occurrence area is located 3 km west of the Village of Hilden, Colchester County (Fig. 4-10). This area has been the subject of previous investigations for gypsum, sulphur and barite and subsequently a number of diamond-drill holes have been put down in the area. An area of karst topography with gypsum heads can be found just north and northeast of Maritime Tel and Tel's relay station facility located in the middle of this area.

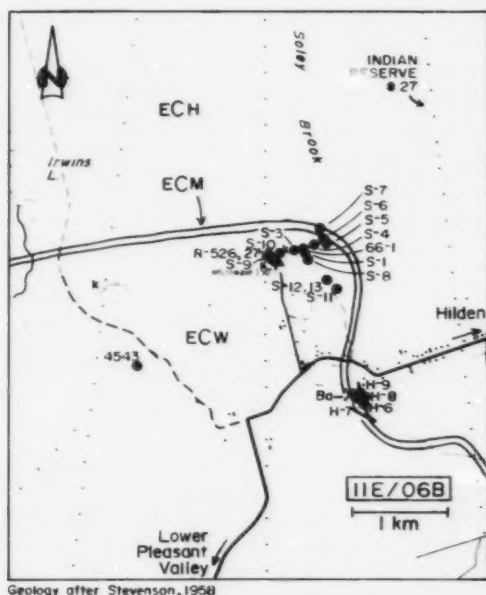


Figure 4-10. Location and geology of the Hilden occurrence area. See Figures 4-1 and 4-2 for legend and location.

Regional geological mapping by Stevenson (1958) appears to be simplified for this area. A series of 14 drillholes, completed by New Senator-Rouyn Ltd. and Peel-Elder Ltd. in 1966-67 (Campbell, 1967) as well as one completed by the Nova Scotia Department of Mines in 1966 (Nova Scotia Department of Mines, 1966), indicated that units underlying this area are dipping steeply ($+50^\circ$) to the south-southeast. Carbonates are rarely described in these holes and no stratigraphic interpretation has yet been attempted. Much of the area appears to be underlain by the sulphate dominated

Carrolls Corner Formation which is underlain to the north and east by Macumber Formation and Horton Group clastics.

Native sulphur was first noted at Hilden (Johnsons Crossing) in the 1870s (Louis, 1878). Hole 66-1, drilled by the Nova Scotia Department of Mines, encountered native sulphur and led to the New Senator-Rouyn Ltd. and Peel-Elder Ltd. drilling. Although 5 of 14 holes contained significant sulphur, no additional drilling has been carried out for sulphur at Hilden. The sulphur is found as fracture fillings and blobs associated with calcite, anhydrite and hydrocarbons in the thick basal sulphate horizons. Its emplacement appears to be structurally related. A biopigenetic origin is indicated for some of the mineralization.

Anhydrite units at Hilden are variously described as massive, fine grained, blue grey to dark grey, medium grained, with up to 20% intermixed carbonate. Hydration is quite shallow with the thickest gypsum found in a narrow, northeasterly trending zone of karst topography just north and east of the Maritime Tel and Tel relay facility. The best gypsum section encountered is found in hole 66-1 where 7.9 m of overburden overlies 23.2 m of light to dark grey, coarse grained, selenitic gypsum. Similar gypsum sections can be observed in other holes, however these are overlain by a clastic unit which may belong to the MacDonald Road or Green Oaks Formations.

The Hilden area is of great interest geologically due both to its structural complexity and presence of native sulphur. Sufficient volumes of gypsum are probably not available to be of interest to a gypsum producer.

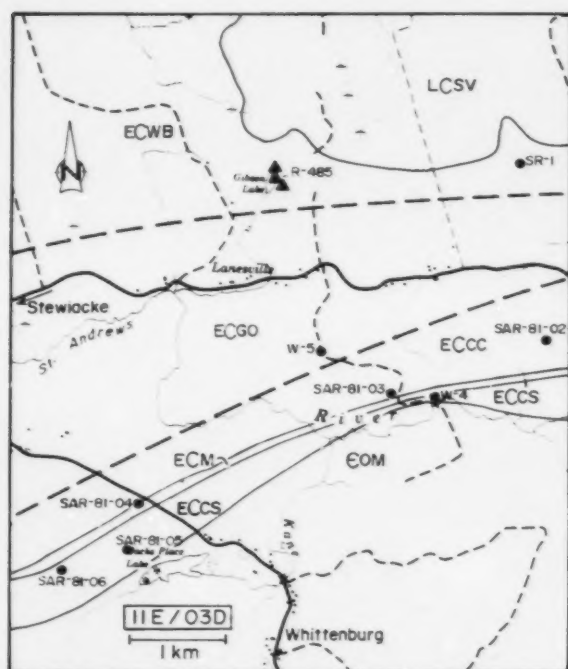
LANESVILLE (0122)

NTS 11E/03C, 11E/03D

UTM 481560 E 4998700 N

The Lanesville occurrence area is located 8 km east of the Town of Stewiacke, Colchester County (Fig. 4-11). It consists of one surficial occurrence as well as several drillhole intersections. The area is intersected by two major faults which complicate the local geology.

Regional geological mapping by Giles and Bochner (1982) indicated that the area where gypsum is found at surface northeast of Gibson Lake is underlain by units of the Canso Group Watering Brook Formation. These interbedded clastics and minor sulphates strike east-west through the area and dip generally northward into the Stewiacke Syncline under clastics of the Scotch Village Formation. Southward, across a fault, lie the interbedded clastics, carbonates and minor sulphates of the



Geology after Giles and Bochner, 1982

Figure 4-11. Location and geology of the Lanesville occurrence area. See Figures 4-1 and 4-2 for legend and location.

Upper Windsor Green Oaks Formation which are in turn in fault contact, to the south, with basal Windsor Group, Carrolls Corner and Macumber Formations.

Within the Lanesville area both Aurum's SR-1 drillhole (Aurum Gold Mines Ltd., 1973) and Rio Tinto's W-3 (Shewman, 1973a) (see Fig. 4-20 for location) were collared in the Watering Brook Formation and penetrated down as far as the top of Cycle 2 (B Subzone) MacDonald Road Formation. Rio Tinto also drilled a hole to the south (W-5) which collared in the Green Oaks Formation and penetrated into the top of the MacDonald Road Formation (Keech, 1982). Five holes, drilled along the Windsor-Horton contact by Placer Development Ltd. in 1981, help to define this contact (Keech and Davidson, 1981).

Gypsum outcrops at Lanesville include several 1-2 m² exposures of interlaminated, dark grey, selenitic, dirty gypsum with white satin spar 'interlaminae'. Limited karst topography can be seen in the immediate vicinity. Drilling results show minor gypsum and anhydrite horizons in clastic dominated sections, generally at depth in the Watering Brook and Green Oaks Formations, as well as, very thin hydrated sections under

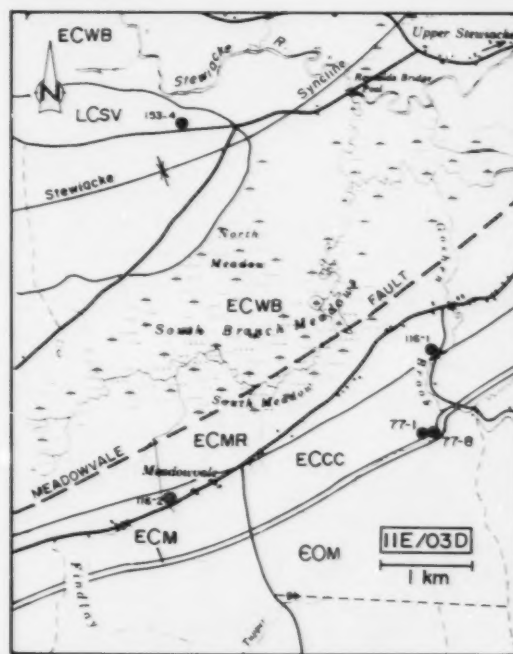
thick overburden in the Carrolls Corner Formation. Little or no economic potential exists for the Lanesville occurrence area.

MEADOWVALE (0157)

NTS 11E/03D

UTM 498000 E 5002500 N

The Meadowvale occurrence area is located 7 km south-east of Upper Stewiacke, Colchester County (Fig. 4-12). Although some hummocky terrain has been noted in this area previously, it is doubtful that it can be attributed to karst topography. The information about this occurrence consists of drillhole information from exploration programs carried out by St. Joseph Explorations Ltd. in 1974-75 (Jowett, 1974; St. Joseph Explorations Ltd., 1975) and by N. L. Industries Inc. in 1978 (Carrol, 1978).



Geology after Giles and Bochner, 1982

Figure 4-12. Location and geology of the Meadowvale occurrence area. See Figures 4-1 and 4-2 for legend and location.

Situated along the southern margin of the Shubenacadie Basin, the Meadowvale area is underlain by easterly trending units of the Lower Windsor and Canso Groups which dip to the north. According to Giles and Bochner (1982), this area is underlain by the sulphate dominated Carrolls Corner Formation which overlies the basal Macumber Formation carbonate to the

south. The Carrolls Corner is deeply eroded along this contact, being covered by a thickness of up to 72.2 m of glacial till and solution fill material. Infilled lenses of similar material were noted to depths of 220.7 m (St. Joseph Explorations Ltd., 1975). The salt dominated Carrolls Corner Formation equivalent, the Stewiacke Formation, is seen at depth in the Meadowvale area as well. Carrolls Corner Formation units are overlain to the north by the interbedded sulphates, carbonates and clastics of the MacDonald Road Formation in the eastern portion of this area, however it is in fault contact with the Watering Brook Formation of the Canso Group to the north in the western portion of the area west of the map area.

This occurrence is of geological interest only. Extremely thick overburden would prevent development of any potential gypsum/anhydrite deposits which might exist along the margin of the Shubenacadie Basin.

MIDDLE STEWIACKÉ (0152)
 NTS 11E/03D
 UTM 486900 E 5008800 N

The Middle Stewiacké occurrence area is located 8 km east of the Village of Brookfield, Colchester County (Fig. 4-13). It consists of several drillholes and a surface outcrop area found in two fault-bound blocks of Lower Windsor which lie just north of Route 289 between Brenton Brook on the west and Putnam Brook on the east.

Regional geological mapping by Giles and Bochner (1982) indicated that two small synclines containing units of the MacDonald Road, Carrolls Corner and Macumber Formations and underlain by Horton Group clastics are located in this area. These units are in fault contact with Upper Windsor Group Green Oaks Formation units to the south. Drilling was carried out during exploration for barite in these areas in 1948 and 1963 by Maritime Barytes Ltd. (Airth, 1948) and N. L. Industries Inc. (Boyle and MacLeod, 1979) respectively. Interpretation of drillhole information by Boyle and MacLeod (1979) indicated that these areas are highly faulted.

The single area of surficial outcrop contains several small round exposures of light brown, medium grained, selenitic gypsum. The best drillhole intersection was in hole 1350, drilled in 1948 in the eastern part of this area (Airth, 1948). It apparently collared and stopped in the Carrolls Corner Formation and encountered good gypsum horizons with clay filled solution intervals common.



Geology after Giles and Bochner, 1982

Figure 4-13. Location and geology of the Middle Stewiacké occurrence area. See Figures 4-1 and 4-2 for legend and location.

The Middle Stewiacké occurrence is of geological interest, but not of economic interest regarding gypsum and anhydrite. The fault-bound blocks found are too small to contain sufficient volumes of material required to open a gypsum quarry.

NEWTON MILLS (0117)
 NTS 11E/02C
 UTM 504840 E 5007350 N

The Newton Mills occurrence area is located 5 km east of Upper Stewiacké, Colchester County (Fig. 4-14). It includes surface and subsurface occurrences from Fulton Brook in the northeast to Blackie Brook in the southwest.

Regional geological mapping by Giles and Bochner (1982) indicated a straightforward geological sequence underlying this area. The sulphate-dominated Carrolls Corner Formation underlies much of the area striking northeast-southwest and dipping to the northwest. It is overlain to the northwest by Cycle 2 (B Subzone) MacDonald Road Formation. To the southeast the sulphates are underlain by the basal Windsor Gays River carbonate and then clastics of the Coldstream Formation of the Horton Group and metamorphics of the Meguma Group.

Three drillholes as well as two areas of gypsum and anhydrite outcrops with associated karst are found within the occurrence area. Amax Exploration Inc. drilled three holes through portions of the Carrolls Corner Formation into clastics in 1974 as part of a regional base metal exploration program (Amax Exploration Inc., 1974c). These were spaced about 2 km apart with F-100 located just east of Blackie Brook, F-99 just west of Route 336 and F-101 collared on the eastern side of Fulton Brook. All three were located in stream valleys.

also noted in the extensive sulphate outcrops seen further up Fulton Brook to the northeast. Several exposures can be seen, some of which are over 15 m in height and up to 100 m in length. These consist primarily of massive, fine grained, light blue anhydrite with only thin hydrated caps in their uppermost portions. Thicker hydrated zones may exist away from the Brook where karst topography can be seen. This area abuts the Eastville occurrence area to the north and northeast.

Large volumes of high purity anhydrite exist in this area and significant areas of karst can also be seen. These factors suggest good potential for significant gypsum to be found in the Newton Mills area. Further drilling is required to determine the average depth of hydration as well as areas of deeper hydration such as the basal contact which may be found here. The closest shipping point for the area would be the new facilities located at Sheet Harbour, 60 km to the southeast.

UTM 498000 E 5009500 N

The Otter Brook occurrence area is located 4 km northwest of Upper Stewiacke, Colchester County (Fig. 4-15). No surface exposures were found in this vicinity, however there are a number of hectares of karst topography and several drillholes have intersected gypsum and anhydrite.

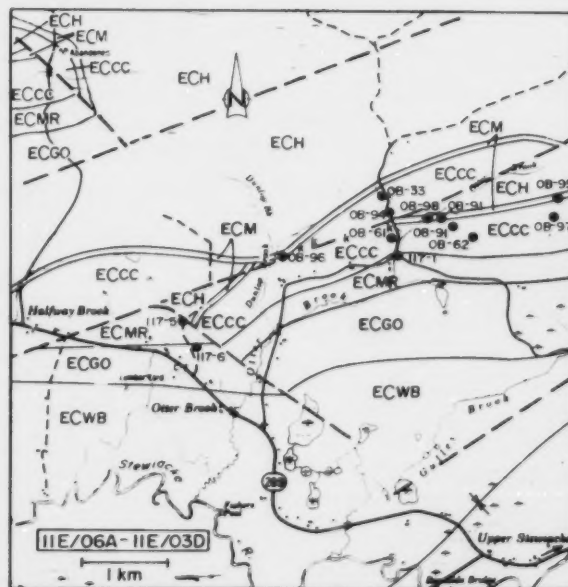


Figure 4-15. Location and geology of the Otter Brook occurrence area. See Figures 4-1 and 4-2 for legend and location.

Regional mapping by Giles and Bochner (1982) indicated that the geology of this area is highly faulted which is characteristic of the northern edge of the Shubenacadie Basin. A number of faulted blocks of easterly trending, steeply southward dipping Lower Windsor strata have been interpreted using results of a number of diamond-drill holes by St. Joseph Explorations Ltd. (Jowett, 1974) and Amax Exploration Inc. (Lebel, 1974a). These strata are part of the sulphate dominated Carrolls Corner Formation and towards the Shubenacadie Basin centre (south) of the salt-dominated Stewiacke Formation. They are overlain by the interbedded sulphates, carbonates and clastics of the MacDonald Road Formation which is overlain by the Upper Windsor Green Oaks Formation. The Carrolls Corner Formation is underlain to the north by the basal carbonate Macumber Formation and the clastics of the Horton Group.

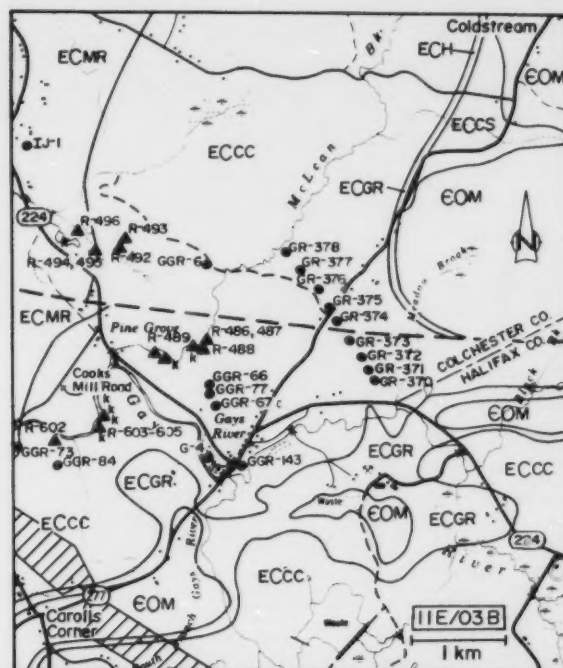
The best gypsum intersection in the Otter Brook area was encountered in hole OB-97 where 63.7 m of soft, white gypsum is overlain by 11.6 m of overburden (Amax Exploration Inc., 1974d). Although this section appears very promising, other holes in the basal sulphate drilled further out into the Basin contain only shallow hydration underlain by massive anhydrite. Also, holes drilled along the Basin margin in areas to the west show typical deep dissolution and infilling with younger clastic material.

Additional drilling should be carried out in the Otter Brook area, especially in the higher ground northeast of hole OB-97 where some of the thicker gypsum sections may be preserved. The volume of potentially minable material would probably be small, however high purity might permit production of stone for specialty plaster applications. Shipments could be made via Sheet Harbour located 60 km south-southeast of this area.

PINE GROVE (0123)
NTS 11E/03B
UTM 471500 E 4987400 N

The Pine Grove occurrence area is located 5 km south-east of Shubenacadie, Hants County (Fig. 4-16). It includes several surficial occurrences as well as numerous drillhole intersections in an area which extends from Carrolls Corner in the southwest to Coldstream in the northeast and the Gays River area in the southeast.

This area lies just northeast of the Gays River lead/zinc mine and has been the subject of much drillhole investigation. As a result, regional geological mapping by Giles and Bochner (1982) is more detailed in the



Geology after Giles and Bochner, 1982
National Gypsum (lease)

Figure 4-16. Location and geology of the Pine Grove occurrence area. See Figures 4-1 and 4-2 for legend and location.

area. Generally, units strike northeast-southwest and dip into the Shubenacadie Basin to the west-northwest. Most of the Pine Grove area is underlain to the west by interbedded and intermixed sulphates, clastics and carbonates of the MacDonald Road Formation. It is also underlain to the east by the carbonate dominated Gays River Formation which is in turn underlain by Cambro-Ordovician Meguma Group metamorphic rocks. At least one major fault passes through this area, offsetting the Windsor Group strata.

At least 19 drillholes were put down through the sulphate horizons in this area between 1971 and 1974 by Texas Gulf Sulphur Company (Mann, 1972), Getty Mines Ltd. (Getty Mines Ltd., 1974, 1975) and Imperial Oil Ltd. (Burton, 1974b). Most of these holes collared in the Cycle 1 (A Subzone) Carrolls Corner Formation and were stopped in the Meguma Group. Only two holes, Imperial's IJ-1 and Getty's GGR-73, collared in the Cycle 2 (B Subzone) MacDonald Road Formation and only IJ-1 penetrated to basement.

Surface exposures can be found at three separate locations within the Pine Grove area. The most extensive is located along the eastern side of Gays River between Cooks Mill Road and the entrance of McLean

Brook into Gays River where approximately 250 m of continuous exposure between 5-10 m in height can be found. Gypsum in these outcrops is light to medium grey in colour, nodular to laminated with variable amounts of intermixed dark grey selenite and dark brown carbonate. Laminae are generally subhorizontal. Moderate to heavy karst topography can be found paralleling this exposure up to 200 m away from McLean Brook. A second area is found between 0.6-1.3 km upstream above where MacLean Brook empties into Gays River. Here three separate outcrops, each 10 m high and up to 40 m long, can be seen. Light blue-grey anhydrite predominates these exposures and only thin surface hydration to fine grained, white gypsum can be observed. The third area is located in and around a series of gravel pits just northeast of Route 224 and northwest of Pine Grove. Here a series of small rounded outcrops of white to light grey gypsum with minor interstitial carbonate have been exposed by the aggregate operations. Also, small anhydrite exposures can be found a short distance to the east of the gravel pits. According to Giles and Bochner (1982), this area is located near the contact between the Cycle 2 (B Subzone) MacDonald Road Formation and the Cycle 1 (A Subzone) Carrolls Corner Formation.

Most of the drilling encountered massive, light blue-grey, basal anhydrite with only thin (<10 m) hydration at the top, usually overlain by 15-75 m of overburden. The greatest thickness of gypsum in the Pine Grove area was encountered in drillhole GGR-84 where 60 m of medium grey, dirty, mixed, selenitic gypsum, with common mudstone intervals up to 1 m thick, is overlain by 30 m of overburden (Getty Mines Ltd., 1975). This drillhole is along strike from the extensive outcrop and karst area found south of the Gays River. Hole GGR-73, down dip from GGR-84, encountered a similar section, however it is overlain by thicker clay interbeds. Hole LJ-1 also encountered a thick, dirty gypsum section (51 m) which may correlate with the others, but which is covered by an even greater thickness of interbedded clastics and carbonates. Descriptions of all of these sections (Burton, 1974b) appear to be very similar to the mining section at National Gypsum Canada's East Milford Quarry.

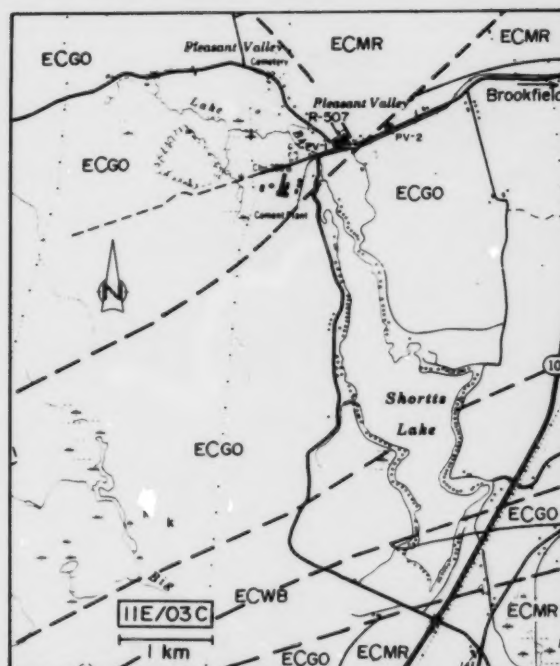
This area has good potential for development of gypsum resources in the area south of the Gays River in the vicinity of GGR-84. Much further work would be required to prove minable reserves, but the thick hydration in this drillhole, as well as extensive outcrop and karst topography, indicate that this is an excellent area for further investigations.

PLEASANT VALLEY (0150)

NTS 11E/03C

UTM 474300 E 5009800 N

The Pleasant Valley occurrence area is located 3.5 km west of the Village of Brookfield, Colchester County (Fig. 4-17). It consists of a small surface exposure as well as an intersection of thin sulphate interbeds in a base metal exploration drillhole.



Geology after Giles and Bochner, 1982

Figure 4-17. Location and geology of the Pleasant Valley occurrence area. See Figures 4-1 and 4-2 for legend and location.

Regional geological mapping by Giles and Bochner (1982) indicated that much of this area is underlain by the interbedded clastics, carbonates and sulphates of the Green Oaks Formation. These units are underlain by interbedded sulphates, carbonates and clastics of the MacDonald Road Formation to the north and are overlain by interbedded clastics and sulphates of the Watering Brook Formation to the south. The area is cut by at least one major fault trending northeast-southwest.

Imperial Oil Ltd. drilled two holes in the Pleasant Valley area in 1974 (PV-1 and PV-2) as part of a regional base metal exploration program (Hannon and Hannon, 1974). Hole PV-1 collared and stopped in silt-

stone and hole PV-2 intersected what appears to be a disturbed section of the bottom of the Green Oaks Formation and a faulted portion of the MacDonald Road Formation containing silty gypsum/anhydrite horizons near the bottom of the hole. A small 2 m² rounded outcrop of light grey, selenitic gypsum can be found just north of the Pleasant Valley Road in what appears to be an old quarry area. Approximately 4 km to the south, several areas of light to moderate karst topography can also be found in an area believed to be underlain by the Green Oaks Formation.

The Pleasant Valley area holds little economic potential for gypsum and anhydrite. The small outcrop area is believed to be part of the top of the MacDonald Road Formation. This section, like the lower part of the Green Oaks Formation, has minor sulphate horizons interbedded with thick clastic units as well as carbonate units and therefore it probably does not contain minable reserves of gypsum and anhydrite.

PRINCEPORT (0147)

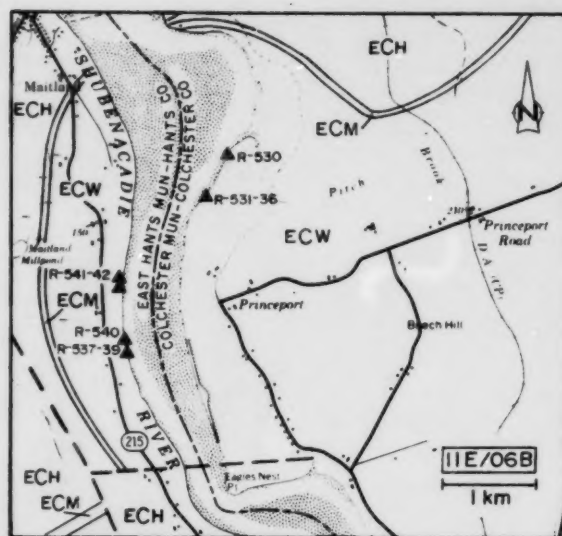
NTS 11E/06B

UTM 462860 E 5016300 N

The Princeport occurrence area is located 15 km southwest of the Town of Truro, Colchester County (Fig. 4-18). It consists of a series of outcrops on the eastern and western banks of the Shubenacadie River containing interbedded sulphates, carbonates and clastics. This occurrence area is in Colchester County and in Hants County. No diamond-drill hole records are available in this area.

Mapping by Stevenson (1958) indicated that much of the area is underlain by the lower part of the Windsor Group. Additional work would be required to more accurately determine the Windsor Group stratigraphy in the area. These units lie in the western end of a small basin and generally dip to the south and east. They are underlain to the north and west by basal Windsor Group Macumber Formation and then by Horton Group clastics.

Outcrops on the eastern side of the Shubenacadie River in this area consist of a number of heads of different types of gypsum separated by concealed or brecciated mudstone sections. Gypsum varies from white, fine grained, massive and highly pure to light reddish brown, selenitic and nodular with medium grey, intermixed dolomite. These heads range from flat lying to 10 m in height and from 5-35 m in width. These units probably belong to the upper part of the MacDonald Road Formation or the Green Oaks Formation.



Geology modified after Stevenson, 1958

Figure 4-18. Location and geology of the Princeport occurrence area. See Figures 4-1 and 4-2 for legend and location.

Two exposures on the western side of the Shubenacadie River are found 3 km south of the Village of Maitland, Hants County. Both exposures are interbedded with red brecciated siltstones similar to those on the eastern side of the River.

The area is of geological interest only; the contorted and recrystallized gypsum outcrops suggest a greater degree of structural deformation than is indicated by Stevenson's map (1958). Units present appear to belong to the upper part of the MacDonald Road Formation or the Green Oaks Formation, however much more work is required to map the local geology in detail. There appears to be little opportunity for economic development in this area.

SMITHFIELD (0154)

NTS 11E/06A

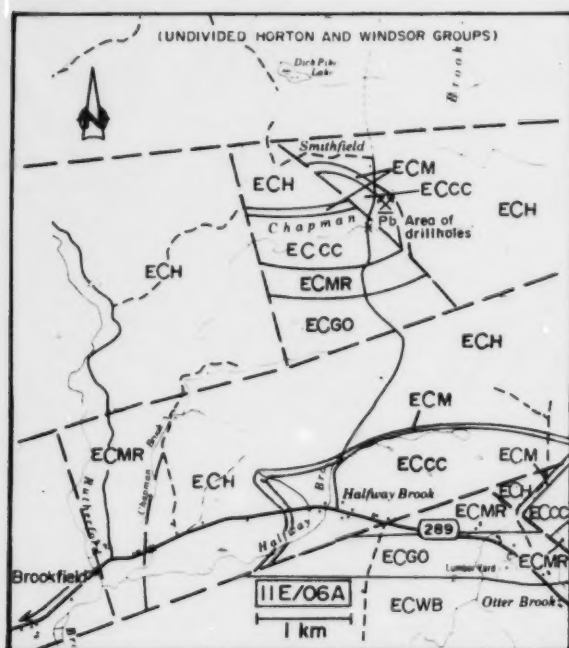
UTM 494000 E 5012400 N

The Smithfield occurrence area is located 15 km east-northeast of the Village of Brookfield, Colchester County (Fig. 4-19). Gypsum and anhydrite have been intersected in base metal exploration drillholes put down by Corporation Administrative Services Limited (Nova Scotia Department of Mines, 1965a) and Granges Exploration AB (Zbitnoff, 1983) in this vicinity although no outcrops of either have been found to date.

Regional mapping (Giles and Bochner, 1982) indicated that the Smithfield area is underlain by a small

isolated block of Windsor Group strata surrounded by Horton Group clastics. The area is highly faulted as are most of the Windsor-Horton contacts. Drilling around the Smithfield lead occurrence indicated deep dissolution along the basal Windsor contact with extensive infilling of clastic materials in both the Macumber and Carrolls Corner Formations (Zbitnoff, 1983). As drilling has been concentrated in the vicinity of the lead occurrence, little is known about the extent and hydration of the Carrolls Corner Formation away from the contact.

The Smithfield occurrence is of geological interest only. The faulted nature and limited extent of the Windsor Group block would greatly restrict the size of any potential gypsum and anhydrite bodies which might be found here.



Geology after Giles and Boehner, 1982

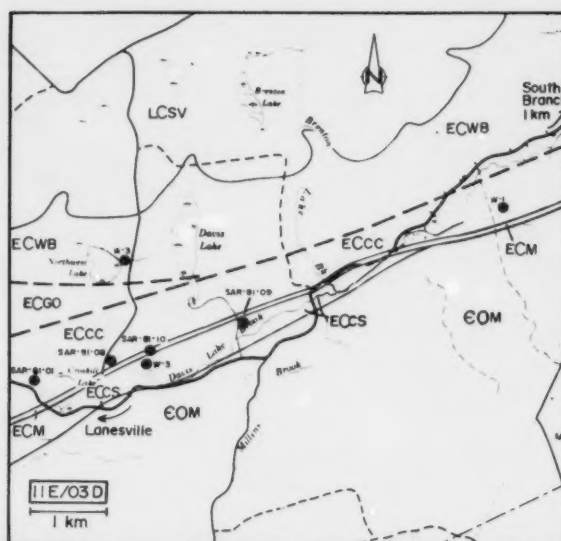
Figure 4-19. Location and geology of the Smithfield occurrence area. See Figures 4-1 and 4-2 for legend and location.

SOUTH BRANCH (0158)

NTS 11E/03D

UTM 487000 E 4998000 N

The South Branch occurrence area is located 13 km east of the Town of Stewiacke, Colchester County (Fig. 4-20). No surface exposures of gypsum or anhydrite are known



Geology after Giles and Boehner, 1982

Figure 4-20. Location and geology of the South Branch occurrence area. See Figures 4-1 and 4-2 for legend and location.

in the area, however drilling carried out by Rio Tinto Canadian Exploration Ltd. in 1973 (Shewman, 1973a) and by Placer Development Ltd. in 1981 (Keech, 1982) encountered sulphate units in the subsurface.

Regional geological mapping by Giles and Boehner (1982) showed this area to be underlain by the sulphate dominated Carrolls Corner Formation which strikes east-west and dips to the north into the Stewiacke Syncline. The Carrolls Corner Formation is underlain to the south by the basal carbonate Macumber Formation which overlies clastics of the Horton Group Coldstream Formation and Meguma Group metamorphics. Basinward to the north, the Carrolls Corner Formation is in fault contact with Upper Windsor Group Green Oaks Formation and Canso Group Watering Brook Formation.

Similar to occurrences elsewhere along the Shubenacadie Basin margin (i.e. Eastville (0115), Newton Mills (0117)), hydration of the basal sulphate is shallow away from the Windsor-Horton contact and at the contact the gypsum appears to have been dissolved and the solution trench infilled by clastic material. Significant volumes of high purity anhydrite with shallow overburden may be available in the eastern portion of this area, however there appears to be little potential for reserves of gypsum.

STEWIACKÉ (0118)
 NTS 11E/03C
 UTM 474500 E 5000000 N

The Stewiacké occurrence area is comprised of two surficial and several subsurface occurrences of gypsum and anhydrite (Fig. 4-21). These are located to the north and east of the Town of Stewiacké, Colchester County. Atypically, the gypsum found at surface in this area belongs in the Watering Brook Formation at the base of the Canso Group which overlies and forms the transition of the Windsor Group in which most of the Province's gypsum is found.

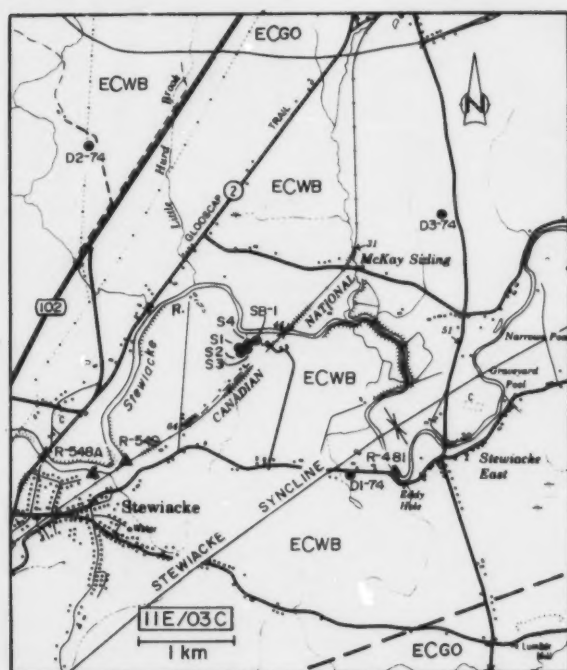


Figure 4-21. Location and geology of the Stewiacké occurrence area. See Figures 4-1 and 4-2 for legend and location.

Regional mapping in the area by Giles and Boehner (1982) indicated that the area is on the northern side of the northeasterly-southwesterly trending Stewiacké Syncline. The area is underlain by interbedded clastics, sulphates and minor halite units of the Watering Brook Formation which are underlain to the north and west by mixed clastics, carbonates and minor sulphates of the Upper Windsor Green Oaks Formation. The Watering Brook Formation is also in fault contact with the Green Oaks Formation to the southeast.

There are outcrops of gypsum immediately north of the Town of Stewiacké along the southern bank of the

Stewiacké River. Several small occurrences, 0.25-1 m high by 4 m wide, can be found here. They consist of light to medium grey, medium- to coarse-grained gypsum with some dolomite and shale interbeds. Another outcrop can be found 3 km east of Stewiacké again on the southern bank of the Stewiacké River. This outcrop, 1.5 m high by 5 m wide, consists of interbedded, dark grey, selenitic gypsum and medium grey siltstone with satin spar filled fractures. Neither area has associated karst topography which would indicate any significant thickness or extent of gypsum units.

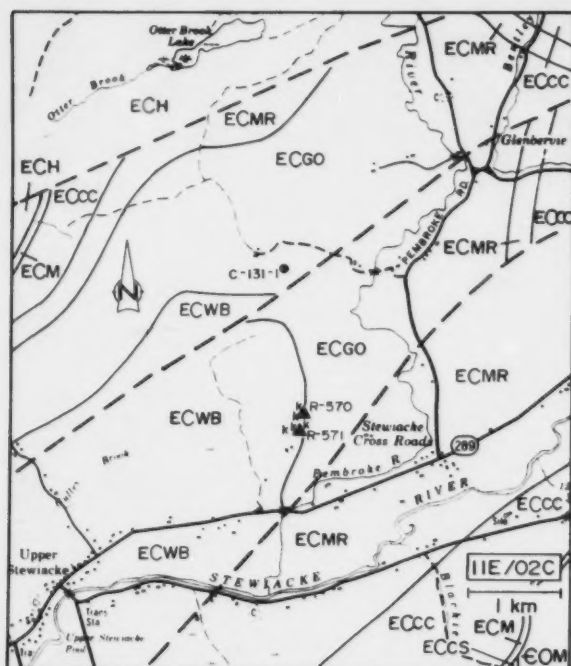
A total of eight diamond-drill holes have been put down in this area including four holes (S1-S4) in 1971 by Denison Mines (Avison, 1972), three (D1-74, D2-74, D3-74) in 1974 also by Denison (Chan, 1974) and one deep hole (SB-1) by U.S. Borax in 1976 (Boehner, 1986). Denison's drilling was part of a regional base metal exploration program. The U.S. Borax hole (SB-1) began as a base metal exploration hole and extended to a final depth of 892.45 m in order to gain stratigraphic information.

All but one of these eight drillholes encountered gypsum and anhydrite. Holes S1, S2, S3 and D2-74 encountered interbedded and intermixed gypsum, grey mud rocks, redbeds and locally thin salt of the Watering Brook Formation. Both S4 and D1-74 are believed to have penetrated as far as the top of the Cycle 2 (B Subzone) of the Windsor Group (Giles and Boehner, 1979) and encountered anhydrite of the MacDonald Road Formation as well as gypsum of the Watering Brook Formation. Hole SB-1, having penetrated the entire Windsor Group and stopped in Horton Group clastics, also encountered anhydrite in the Stewiacké and Carrolls Corner Formations.

None of these intersections nor the surficial occurrences are of economic importance. The intermixed and interbedded nature of the gypsum horizons in the Watering Brook Formation makes them too impure to be of interest even at surface. Other horizons encountered are far too deep to warrant further consideration.

STEWIACKÉ CROSS ROADS (0156)
 NTS 11E/02C
 UTM 503100 E 5009400 N

The Stewiacké Cross Roads occurrence is located 1500 m west of the intersection of Route 289 and the Pembroke Road (Fig. 4-22). It consists of an area of moderate to heavy karst topography containing several gypsum exposures.



Geology after Giles and Boehner, 1982

Figure 4-22. Location and geology of the Stewiacke Cross Roads occurrence area. See Figures 4-1 and 4-2 for legend and location.

Regional geological mapping by Giles and Boehner (1982) showed excellent bedrock exposure of the Green Oaks Formation just north of this locale. They believed the area to be underlain by the interbedded clastic and sulphate units of the Watering Brook Formation of the Canso Group. These are underlain by Green Oaks Formation of the Windsor Group to the east and cut by faults to the north and south.

Outcrop in this area consists of numerous light grey to medium grey, medium grained gypsum exposures containing +10% intermixed silt and dolomite. The largest is a horseshoe shaped head found 250 m north up a small tributary of the Pembroke River above the cleared area of the Stewiacke Valley. Here the outcrop and screed slope are up to 10 m in height surrounding an apparent sink 30 m in diameter. A small brook appears to emanate from the foot of this exposure. Karst topography extends north, west and south away from these heads.

The Stewiacke Cross Roads area is primarily of geological interest. A few drillholes might be put down to determine the depth and lateral extent of the gypsum under the obviously karsted areas. If these units belong to the Watering Brook Formation, it is unlikely that the sulphate horizons are of sufficient thickness to be of economic interest.

UPPER BROOKFIELD (0151)
NTS 11E/06B
UTM 479030 E 5012400 N

The Upper Brookfield occurrence area is located 3 km northeast of Brookfield, Colchester County (Fig. 4-23). It consists of several outcrop exposures, areas of moderate karst topography and a single drillhole intersecting gypsum, all found along the Little River to the north and east of Brookfield.



Geology after Stevenson, 1958; Giles and Boehner, 1982

Figure 4-23. Location and geology of the Upper Brookfield occurrence area. See Figures 4-1 and 4-2 for legend and location.

Regional geological mapping by Stevenson (1958) and Giles and Boehner (1982) indicated that this highly deformed area has been subjected to much folding and faulting. An easterly trending fault, cutting through the middle of the area brings Horton Group clastics in contact with Lower Windsor Group sulphates and carbonates along the valley of the Little River. The Windsor Group is also underlain by Horton clastics to the north. Felderhof's (1978) description of a barite deposit found just north of the Windsor-Horton contact indicates much structural deformation in this vicinity.

The largest exposure of sulphates in the area is found along the western side of Little River just northwest of Trenholms Lake. A vaguely stratified sequence of massive gypsum and anhydrite underlain by petroli-ferous carbonate-rich selenitic gypsum can be found in heads up to 20 m high and 350 m long. These units appear to strike north-south and dip 20° west. Borate

nodules are common in the fine grained, blue-grey anhydrite. Karst topography and minor heads of gypsiferous anhydrite extend to the north for several hundred metres. These units appear to belong to the Carrolls Corner Formation (not shown on map).

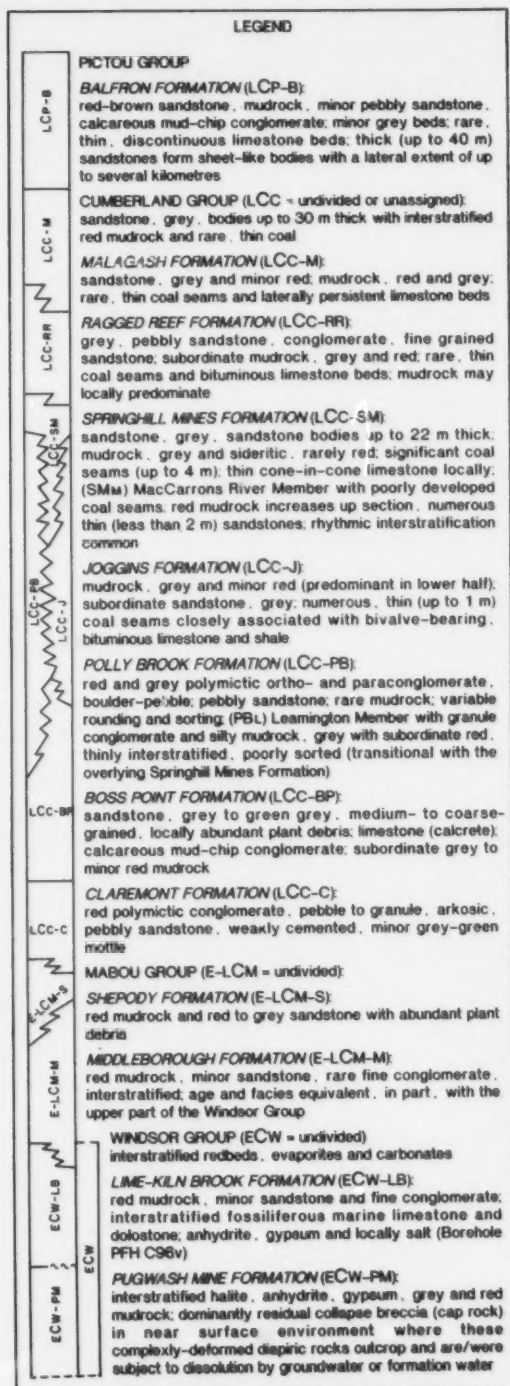
Between 1500-2200 m further up River, a number of gypsum outcrops can be found along the Little River valley. These generally consist of dirty, selenitic gypsum interbeds with brecciated, red, clastic materials. This section is reflected in a drillhole put down by

Corporation Administrative Services Ltd. in 1963 (BR-4) which encountered dark grey, dirty gypsum interbedded with brecciated shales (Hudgins, 1963). Two kilometres further upstream, another area of karst topography and small rounded outcrops can be found in the River valley.

The Upper Brookfield area is structurally complex and geologically interesting. However, due to this complexity and limited areal extent, there is little potential for development of gypsum or anhydrite resources in this area.



CHAPTER 5. CUMBERLAND COUNTY



after Ryan et al., 1990a; 1990b; Ryan and Boehner, 1990

Figure 5-1. Geological legend for Cumberland County gypsum and anhydrite occurrence maps.

SYMBOLS

Gypsum or anhydrite outcrop	▲
Karst topography	k
Rock sample location	R-253
Drillhole location	J-207
Geological contact	—
Fault	—
Thrust fault, barbs point downdip	—
Quarry, active	✕
Quarry, abandoned	✕
Anticline	∩
Syncline	∪
Unconformity	—

Figure 5-1. Continued.

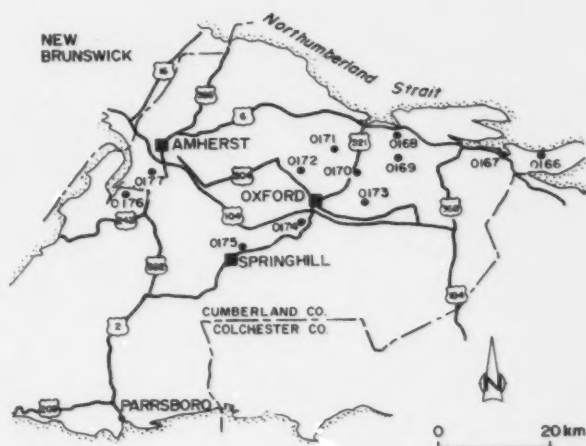
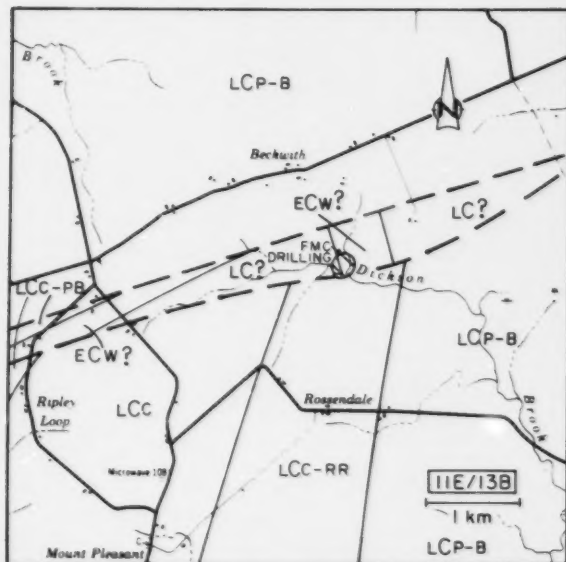


Figure 5-2. Location map for Cumberland County gypsum and anhydrite occurrences by reference number.

BECKWITH (0171)
 NTS 11E/13B
 UTM 436600 E 5074420 N

The Beckwith occurrence is located 10 km north of the Town of Oxford, Cumberland County (Fig. 5-3). A celestite occurrence at this site has been investigated by several companies over the years and diamond drilling by these companies has encountered some gypsum and anhydrite.



Geology after Ryan et al., 1990a

Figure 5-3. Location and geology of the Beckwith occurrence area. See Figures 5-1 and 5-2 for legend and location.

Recent geological mapping by Ryan et al. (1990a) indicated that the immediate vicinity of the occurrence is underlain by a fault-bound block of undivided Windsor Group rocks. These are surrounded by younger clastics of the Cumberland Group Ragged Reef Formation, the Pictou Group Balfron Formation and undefined Late Carboniferous sedimentary rocks. The area is transected by a series of east-west trending faults which result in a very complex local geology.

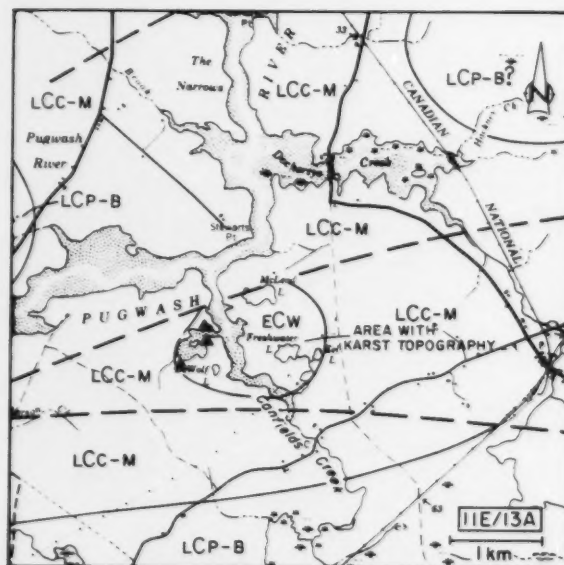
FMC Corp. drilled 36 wireline drillholes and 42 rotary drillholes on this property in 1970 while exploring for celestite (FMC Corp., 1969-71). A total of 36 of these encountered gypsum and anhydrite and many holes which failed to encounter gypsum or anhydrite were stopped at shallow depths. Descriptions of the calcium sulphate horizons are only cursory, however the gypsum appears to become anhydrite rapidly with depth. The gypsum encountered nearest to surface was in hole 111

in which only 11.3 m of overburden overlies 'gypsum-anhydrite'.

The Beckwith occurrence is of geological interest only. The complex geology and highly faulted nature of the area as well as the apparently thin hydration greatly lessen the possibilities of finding an economic deposit in this area.

CANFIELDS CREEK (0169)
 NTS 11E/13A
 UTM 447440 E 5071480 N

The Canfields Creek occurrence area is located 6 km south of the Town of Pugwash, Cumberland County (Fig. 5-4). Several exposures of gypsum have been noted in this area by Ryan et al. (1990a) along the banks of Canfields Creek. Although numerous exploration diamond-drill holes have been completed in a nearby copper prospect, none have penetrated the Windsor Group strata.



Geology after Ryan et al., 1990a

Figure 5-4. Location and geology of the Canfields Creek occurrence area. See Figures 5-1 and 5-2 for legend and location.

Recent geological mapping in the Cumberland Basin by Ryan et al. (1990a) indicated the presence of a roughly circular area which is underlain by the Windsor Group at Canfields Creek. These units are surrounded by much younger Cumberland Group Malagash Formation clastics which unconformably overlie the clastics, carbonates and evaporites of the Windsor Group (Ryan et al., 1990a).

Ryan (personal communication) noted the presence of several small (2 x 4 m), rounded, white to grey, dirty gypsum outcrops in the area. A number of large circular ponds and areas of karst topography can be found in the area as well. No subsurface information is available at present in the Canfields Creek area.

The gypsum occurrence at Canfields Creek is of geological interest only. The limited areal extent of the Windsor Group here, as well as the presence of the Creek which flows through the middle of the low marshy area would probably prevent development.

HANSFORD (0173)

NTS 11E/12C

UTM 440500 E 5062940 N

Located 7 km east of the Town of Oxford, Cumberland County, the Hansford occurrence consists of several small surface exposures of gypsum with accompanying moderate to light karst topography (Fig. 5-5). No drill-hole information is available in the immediate vicinity.

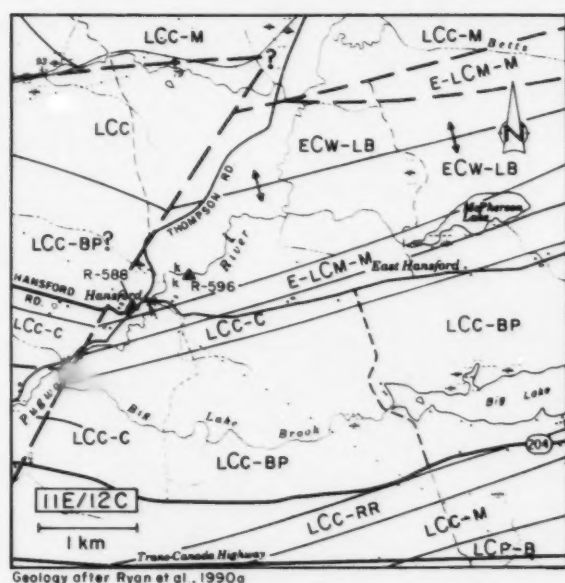


Figure 5-5. Location and geology of the Hansford occurrence area. See Figures 5-1 and 5-2 for legend and location.

Geological mapping of the area by Ryan et al. (1990a) indicated that much of it is underlain by carbonates, clastics and calcium sulphate strata of the Lime-kiln Brook Formation of the Windsor Group. These units strike east-west, are cut to the west by a fault and are flanked to the north and south by younger clastics of the Mabou Group Middleborough Formation.

Gypsum outcrops immediately north of the Hansford Road just west of where it crosses the Thompson Road. The exposure consists of several small, round, light grey gypsum outcrops having common intermixed carbonate material. Gypsum also outcrops 600 m downstream along the Pugwash River below the bridge on the Hansford Road. This exposure consists of a number of blocks of fine grained, white gypsum containing only minor carbonate and selenite. Ryan et al. (1990a) noted the presence of clastic and carbonate outcrop in the area of the second exposure.

Limited exposure and the presence of extensive clastic and carbonate outcrops close by have been interpreted by Ryan et al. (1990a) as belonging to the clastic dominated Lime-kiln Brook Formation. These gypsum exposures are of geological interest; it is unlikely that they will be of economic interest because they are thin and apparently limited in extent.

LAZY BAY (0167)

NTS 11E/14B

UTM 467100 E 5071700 N

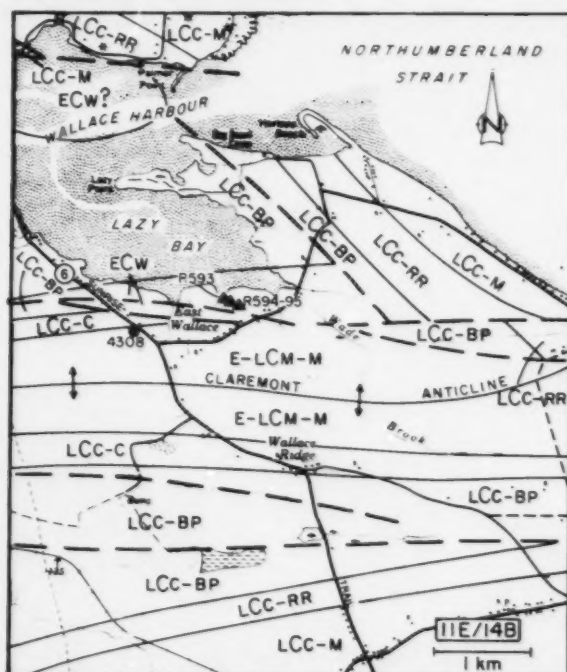
The Lazy Bay occurrence area is located along the southeastern portion of Lazy Bay, 4 km southeast of the Village of Wallace, Cumberland County (Fig. 5-6). An area of gypsum exposures up to 10 m high and 250 m long can be seen from the shore here. Several drillholes have been completed within a few kilometres of the occurrence area, however only one is close to the surface exposures (NSDM hole 4308 in 1966) (Nova Scotia Department of Mines, 1967a).

Geological mapping by Ryan and Bochner (1990) referred to this area of Windsor Group exposures as the Lazy Bay Diapir, a highly contorted sequence of clastics, evaporites and carbonates. These units are in fault contact with younger clastic units of the Mabou and Cumberland Groups which surround them. Ryan and Bochner (1990) also suggested the presence of a second diapir just north-northwest of the one at Lazy Bay. This structure, the Wallace Harbour Diapir, is inferred by a gravity low over that area.

The gypsum exposed at the surface in this area is white to light grey in colour, fine- to medium-grained and contains variable amounts of intermixed silt and limestone material (10-30%). Limestone interbeds found in the outcrop trend east-west and are dipping nearly vertically.

Local residents report that some gypsum was taken from this site to be used in the area for plastering houses. However, there appears to be no indications of

large scale extraction or any historical production figures. This occurrence is of geological interest only. There appears to be insufficient volumes of material to be of economic interest except for perhaps local use as a soil amendment or fertilizer.



Geology after Ryan and Boehner, 1990

Figure 5-6. Location and geology of the Lazy Bay occurrence area. See Figures 5-1 and 5-2 for legend and location.

LOWER MACCAN (0176)

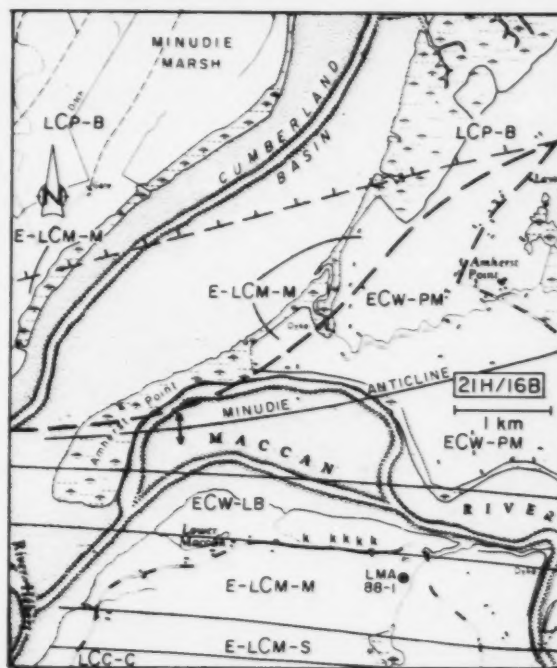
NTS 21H/16B

UTM 400000 E 5068200 N

The Lower Maccan occurrence area is located 9 km southwest of the Town of Amherst, Cumberland County (Fig. 5-7). A series of sinkholes have been noted in this area and anhydrite interbeds have been intersected in the subsurface by Nova Scotia Department of Mines and Energy drillhole LMA 88-1 (Boehner, 1990).

Regional geological mapping by Ryan et al. (1990b) indicated that this area lies along the southern side of the easterly trending Minudie Anticline which extends west to the shores of the Cumberland Basin. Locally, the area is underlain by the interbedded clastics, carbonates and anhydrite of the Lime-kiln Brook Formation which overlies the structurally complex diapiric Windsor Group to the north. Younger clastics of the Middleborough Formation of the Mabou Group overlie Windsor strata to the north and south of the area. The

anhydrite interbeds in LMA 88-1 are thin, generally <5 m with maximum thickness of 13 m and thus are not economically attractive.



Geology after Ryan et al., 1990b

Figure 5-7. Location and geology of the Lower Maccan occurrence area. See Figures 5-1 and 5-2 for legend and location.

Although of no economic interest, the calcium sulphate horizons encountered in LMA 88-1 may facilitate geological interpretations and appraisals of other outcrop areas of Lime-kiln Brook Formation. Gypsum/anhydrite intervals are not seen in surface exposures of the Lime-kiln Brook Formation seen elsewhere in the area, however should drilling be carried out at other locales their presence may assist in correlating between sections.

MALAGASH (0166)

NTS 11E/14B

UTM 474500 E 5070500 N

The Malagash occurrence area is located in the vicinity of the abandoned Malagash salt mine, 11 km east of the Village of Wallace, Cumberland County (Fig. 5-8). No surficial indications of the underlying gypsum or anhydrite occur in this area, however much information is available from the salt mine workings as well as exploration and development drilling which encountered calcium sulphates in the subsurface.

gypsum to its wallboard plant in Montreal. Due to incomplete records of gypsum production compiled by the Nova Scotia Department of Mines in the late 1800s and early 1900s it is not possible to accurately determine how much gypsum was produced from these sites. However, it is unlikely that total production would exceed 300 000 t.

Recent regional mapping by Ryan et al. (1990b) indicated that much of this area is underlain by the structurally disturbed, interbedded evaporites, carbonates and clastics of the diapiric Windsor Group. These are overlain to the south by interbedded clastics, evaporites and carbonates of the Lime-kiln Brook Formation of the Windsor Group which are in turn overlain by clastics of the Middleborough Formation of the Mabou Group. Boehner (1986) gave a much more detailed description of the geology of the area in the section on the Nappan Salt Deposit.

Drilling has been carried out in the Nappan area over the years for oil, salt and gypsum by a number of companies. Maritime Gypsum Co. had 18 holes drilled by the Nova Scotia Department of Mines in 1911-1912 in the vicinity of its quarry. The depth of these holes was 34.4 m and almost all encountered gypsum containing various amounts of clay, sand infilled material as well as anhydrite horizons (Province of Nova Scotia, 1913b). Later, gypsum was again the reason for drill-holes put down by Gypsum, Lime and Alabastine and Domtar between 1957 and 1962 in the same area. During these years at least 43 drillholes were completed in an attempt to prove up additional reserves in and around the quarry.

In addition to drilling for gypsum, a number of deeper holes were drilled in the area to search for oil and salt. Imperial Oil drilled 10 holes in 1929 (Boehner, personal communication) which helped to determine the nature of the local stratigraphy prior to drilling Amherst No. 1 (IA-1) to a depth of 1260 m in 1931 in search of oil. The Nova Scotia Department of Mines drilled three holes in the area to investigate salt horizons encountered by Imperial's Amherst No. 1 well in 1943-44 (Record Nos. 960, 961 and 962) (Province of Nova Scotia, 1944). Finally from 1945 to 1947, Sun Oil Co. Ltd. drilled for oil in the area, going to a total depth of 1981 m in hole 1 and further to 3506 m in a second hole, 14 (S-1, -1A) (Sun Oil Company Ltd., 1947).

Virtually all of the drillholes put down in the central portion of the Minudie Anticline encountered gypsum in their upper portions. Drillhole descriptions vary, however the gypsum is generally quite deeply cut with infilled material and cavities to +30 m. Hydration

extends to +100 m in some holes, but anhydrite was encountered in some holes at depths of <30 m. An evaluation program carried out by Domtar in 1961 on the Nappan gypsum quarry site indicated that the immediate area was structurally complex, with abundant seams of clay, sand and anhydrite (Domtar Gypsum, confidential company report). No reserve estimates were given, but they are believed to have been low.

The Nappan occurrence area appears to contain abundant near surface gypsum which is deeply incised by dissolution features, clastic material, as well as abundant remnant anhydrite lenses and beds. Even if large volumes of gypsum could be delineated here, the problem of removing large amounts of waste would have to be solved in order to make development feasible. A second, greater problem would be transportation of gypsum to markets, the nearest point for shipping being Pugwash located about 55 km east of the area. Should a local consumer ever develop in the area, then it might be possible to develop a small sized gypsum operation at Nappan.

OXFORD (0174)

NTS 11E/12C

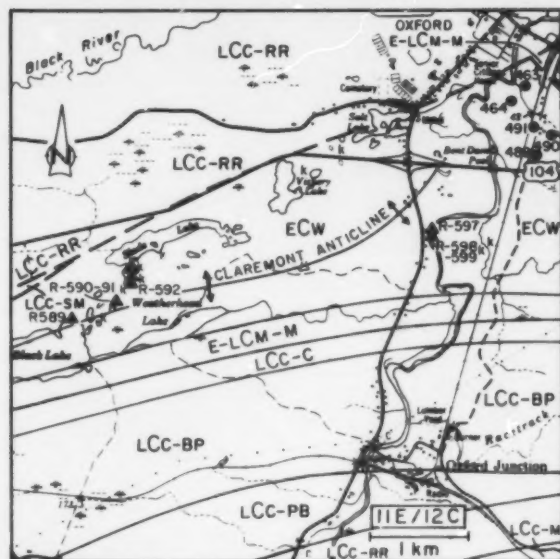
UTM 428600 E 5062200 N

The Oxford occurrence area is located immediately south and southwest of the Town of Oxford, Cumberland County (Fig. 5-10). Karst topography and gypsum exposures can be seen over an area extending 5000 m south and west of the Town and a number of drillholes have intersected calcium sulphate horizons to the south and southeast of Oxford.

Recent regional mapping by Ryan et al. (1990a) indicated that much of this area is underlain by a triangular shaped block of undivided, diapiric Windsor Group rocks. These are unconformably overlain by younger clastics of the Mabou Group Middleborough Formation to the south and east and are in fault contact to the north-northeast with much younger clastics of the Cumberland Group Ragged Reef Formation. Boehner (1986) gave a more detailed description of the area's geology.

Drilling has been undertaken in the Oxford area by three different groups, all for salt or potash. Nova Scotia Department of Mines drills completed a series of five holes for H. A. Patton immediately south of Oxford, two in 1924, the rest in 1926 (Province of Nova Scotia, 1925; 1927a). The Malagash Salt Company Ltd. drilled two holes in 1953 (Malagash Salt Company Ltd., 1953) located 3500 m southeast of Oxford. Nova Scotia Department of Mines drills completed two holes for

Amax Potash Ltd. nearby in 1979 (Nova Scotia Department of Mines and Energy, 1980). Although all holes encountered the Windsor Group, only hole 463 (Province of Nova Scotia, 1925) intersected interesting gypsum thicknesses close to surface (34.2 m gypsum and clay overlain by 15.2 m of overburden).



Geology after Ryan et al., 1990a

Figure 5-10. Location and geology of the Oxford occurrence area. See Figures 5-1 and 5-2 for legend and location.

Surface exposures can be seen in a heavily karsted zone which extends from Black Lake in the southwest to Salt Lake in the northeast. Gypsum found here varies from white to medium grey and orange, from fine grained and massive to coarse grained and sugary and contains variable amounts of intermixed clays and carbonates. This continuous zone, apparently underlain by gypsum is distinctly different from the highly contorted Windsor Group strata found in the eastern part of the occurrence area, however the apparent deep hydration suggests some degree of faulting through this zone.

The western zone of karst found in the Oxford area warrants additional drilling. The abundance of surface water and reports of salt springs at Salt Lake detract from the development potential of this area, however the abundance of karst and gypsum exposures over a large area suggests that large volumes of gypsum and anhydrite may be present here. The deep water port of Pugwash, where the Canadian Salt Company ships out its products, is located about 32 km to the northeast. The Trans-Canada Highway 104 cuts through the north-

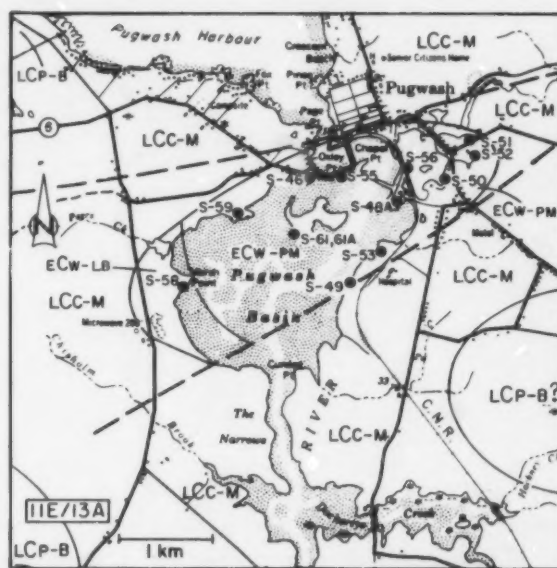
ern portion of the zone between Vickery Lake and Salt Lake providing easy access. Recent investigations into plaster-wood fibre wallboard products could have potential in this area of Cumberland County.

PUGWASH (0168)

NTS 11E/13A

UTM 449040 E 5076640 N

The Pugwash occurrence area is located immediately south and southwest of the Town of Pugwash, Cumberland County (Fig. 5-11). Information on the area is available from exploration and development drilling carried out by the Canadian Rock Salt Co. (Canadian Salt Co. Ltd.) in the early 1950s and 1960s as well as from studies of the underground workings in the Pugwash Mine (Carter, in preparation).



Geology after Ryan et al., 1990a

Figure 5-11. Location and geology of the Pugwash occurrence area. See Figures 5-1 and 5-2 for legend and location.

Regional geological mapping carried out by Ryan et al. (1990a) indicated that much of the area around the Pugwash Basin is underlain by an oval shaped unit of Windsor Group rocks. Much of the area is underlain by highly contorted, interbedded salt and anhydrite of the Pugwash Mine Formation (Carter, in preparation). These strata intruded and are surrounded by much younger clastics of the Cumberland Group Malagash Formation which locally, unconformably overlie the Windsor Group strata. Carter (in preparation) has determined that the highly contorted Windsor units at Pugwash represent a piercement diapir.

Drillhole information, as well as underground studies by Evans (1972) and Carter (in preparation) indicated the highly complex structural nature of the Windsor Group strata at Pugwash. Several holes encountered interesting sections of impure gypsum up to 44.2 m thick under as little as 19.8 m of overburden (S-53) (Nova Scotia Department of Mines, 1953-1962). However, the geology and topography (i.e. presence of the Pugwash Basin) of this area would prevent any development of the gypsum found near surface. Significant volumes of anhydrite are present at Pugwash; thick interbeds are well defined in the salt mine workings. Unfortunately salt is noted as interbeds or intermixed in most anhydrite horizons, a fact which would render the anhydrite useless to most end users. At present, the Pugwash occurrence is of geological interest only. Anhydrite interbeds have been instrumental in geological investigations at the Pugwash Mine enabling workers in their attempts to sort out the complex structure.

PURDY BROOK (0172)
NTS 11E/13B
UTM 429580 E 5070400 N

The Purdy Brook occurrence area is located 6.5 km north-northwest of the Town of Oxford, Cumberland County (Fig. 5-12). One of five diamond-drill holes put down in this area in 1967 by Scurry Rainbow encountered significant thicknesses of gypsum. An area of moderate to heavy karst topography can also be found on the eastern side of Purdy Brook approximately 2000 m north of Route 204.

Regional mapping of the bedrock geology by Ryan et al. (1990a) indicated that much of this area is underlain by the units of the diapiric phase of the Windsor Group. These are overlain to the south and west by clastics of the Middleborough Formation of the Mabou Group and in fault contact to the east and north with much younger clastics of the Polley Brook Formation of the Cumberland Group.

Referring to this area as the Beckwith salt occurrence, Bochner (1986) used Scurry Rainbow drillhole information and Bouger gravity anomaly information to determine the probable presence of an underlying salt mass.

Scurry Rainbow's hole 27-2 encountered 58.5 m of light to medium grey, fine- to medium-grained gypsum with minor intermixed carbonate and clastic materials, overlain by 6.1 m of overburden (Kawase, 1967). However, hole 27-1 drilled nearby (precise location uncertain) drilled through 47.5 m of overburden before encountering 88.7 m of red shales with only minor

gypsum. Holes 27-3 and 27-4 both encountered similar situations, having deep overburden and thick clastic sections. In 27-4 drilling was stopped in anhydrite having a salty taste at 245.7 m. Bochner (1986) suggested that these holes penetrated the steeply dipping, contorted units which overlie a diapiric salt body.

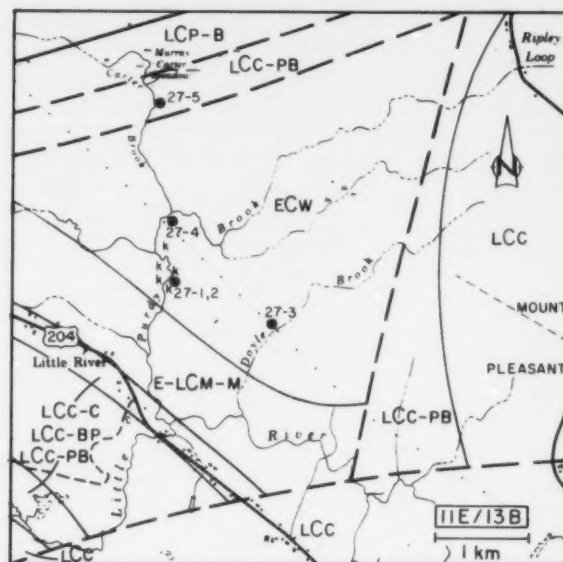


Figure 5-12. Location and geology of the Purdy Brook occurrence area. See Figures 5-1 and 5-2 for legend and location.

Although hole 27-2 did pass through, what was described as a good gypsum horizon and karst topography suggests the presence of an extensive horizon of gypsum in the area, there is insufficient evidence to properly assess this occurrence. If the underlying geology is steeply dipping and highly contorted, as is suggested, then there would be little chance of developing a large gypsum deposit in this area. Additional drilling should be undertaken in the vicinity of 27-2 and the karst area to further assess this occurrence because it is one of the few in this part of the Province having any development potential.

ROSLIN (0170)
NTS 11E/13B
UTM 440500 E 5069500 N

The Roslin occurrence area is located 9 km northeast of the Town of Oxford, Cumberland County (Fig. 5-13). Small blocks of gypsum are seen along the eastern bank of River Philip in this area as well as several areas of light to moderate karst topography. One diamond-drill hole (NSDM 4307) completed by the Department in

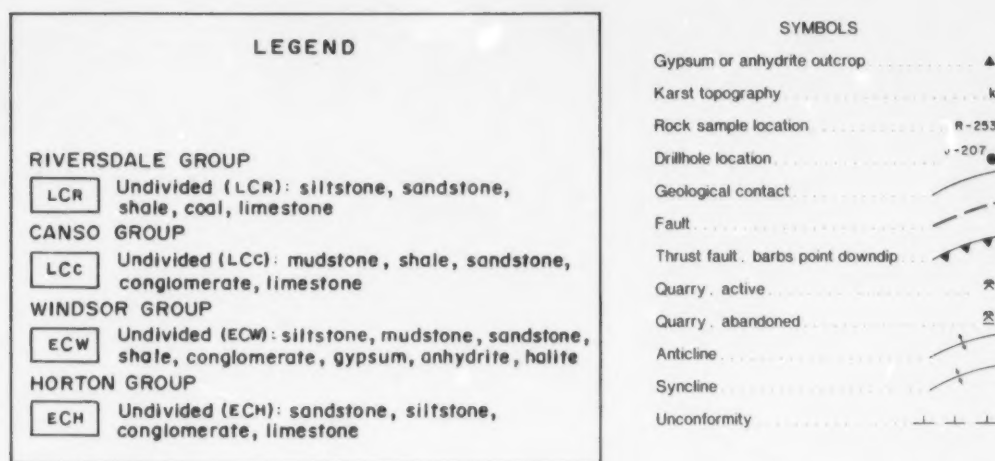
Recent geological mapping of the area (Ryan et al., 1990b) indicated it to be highly faulted, containing several isolated areas underlain by clastics, carbonates and evaporites of the Windsor Group. Most of the area is underlain by clastics of the Cumberland Group. The best documented of these Windsor Group blocks is the Black River Diapir (Boehner, 1986; Calder, 1980) with

numerous salt springs. Drillhole 931 (Province of Nova Scotia, 1943) clearly indicated the presence of Windsor Group strata including evaporites under a small fault-bound area along the Black River just north of Salt Springs.

Drillhole 931 was drilled by the Nova Scotia Department of Mines in 1941-42 to investigate the

geology in the Black River area. It encountered a sequence of interbedded gypsum, anhydrite and shales presumably of Lower Windsor Group. Although apparently thick gypsum horizons were intersected at depth, they were overlain by shales up to 36.6 m thick. This fact, as well as the highly faulted nature of the Windsor Group blocks found in the Springhill area, render them of geological interest only.

CHAPTER 6. GUYSBOROUGH COUNTY



After Weeks, 1964; Keppie, 1979

Figure 6-1. Geological legend for Guysborough County gypsum and anhydrite occurrence map.



Figure 6-2. Location map for Guysborough County gypsum and anhydrite occurrence by reference number.

MULGRAVE (0110)
 NTS 11F/11B
 UTM 629500 E 5044700 N

Two gypsum occurrences have been reported in the Mulgrave area. Both occurrences lie in the same geological setting and are small in extent (Fig. 6-3). The first is located just north of Pirate Harbour, approximately 2 km south of the Town of Mulgrave, Guysborough

County. The second is located just south of Byers Brook 8 km south-southeast of Mulgrave.

Regional geological mapping by Ferguson and Weeks (1950) showed several small areas along the western side of the Strait of Canso which are underlain by Carboniferous Windsor and Canso Group units. These generally strike north-northwest and dip to the east under the Strait of Canso and are underlain to the west by clastics of the Horton Group.

The northernmost occurrence is a surface outcrop reported by Messervey (1946) and Hilton (1954). The size and quality of this gypsum cannot be reported because it was not found during this survey. The gypsum found south of Byers Brook was encountered in two of five diamond-drill holes put down by FMC Corp. in 1971 as part of a celestite exploration program (FMC Corp., 1971). Both holes were drilled at different angles from the same collar. Other holes to the north and south along strike from them failed to encounter gypsum (FMC Corp., 1971). Hole SWC-2 encountered 22.6 m of gypsum with a true thickness of 15.8 m. This unit appears to be what remains of the basal Windsor sulphate horizon.

Neither of these occurrences is of economic significance. The small areal extent of the Windsor Group found on the western side of the Strait of Canso is insufficient to accommodate a sizable gypsum or anhydrite body.

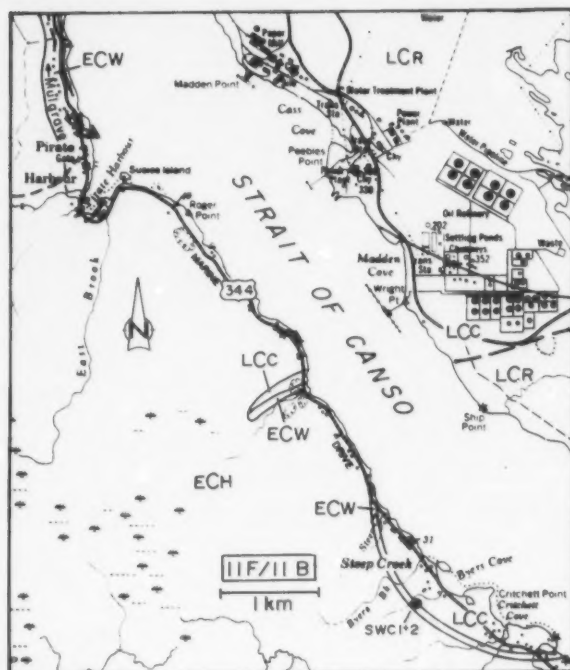
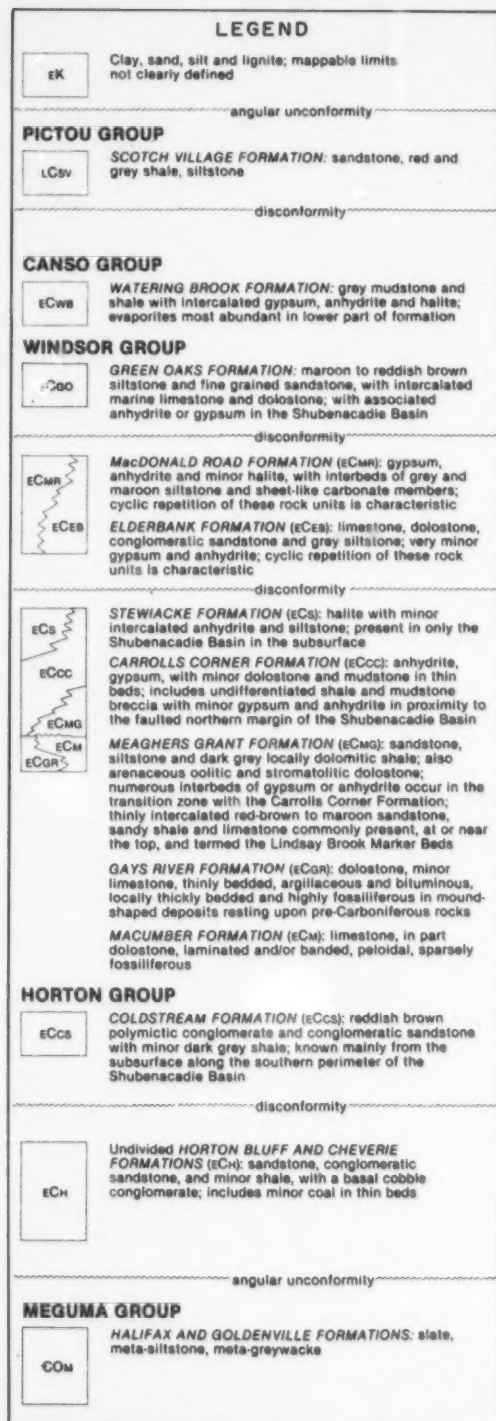


Figure 6-3. Location and geology of the Mulgrave occurrence area. See Figures 6-1 and 6-2 for legend and location.

CHAPTER 7. HALIFAX COUNTY



After Giles and Boehner, 1982

Figure 7-1. Geological legend for Halifax County gypsum and anhydrite occurrence maps.

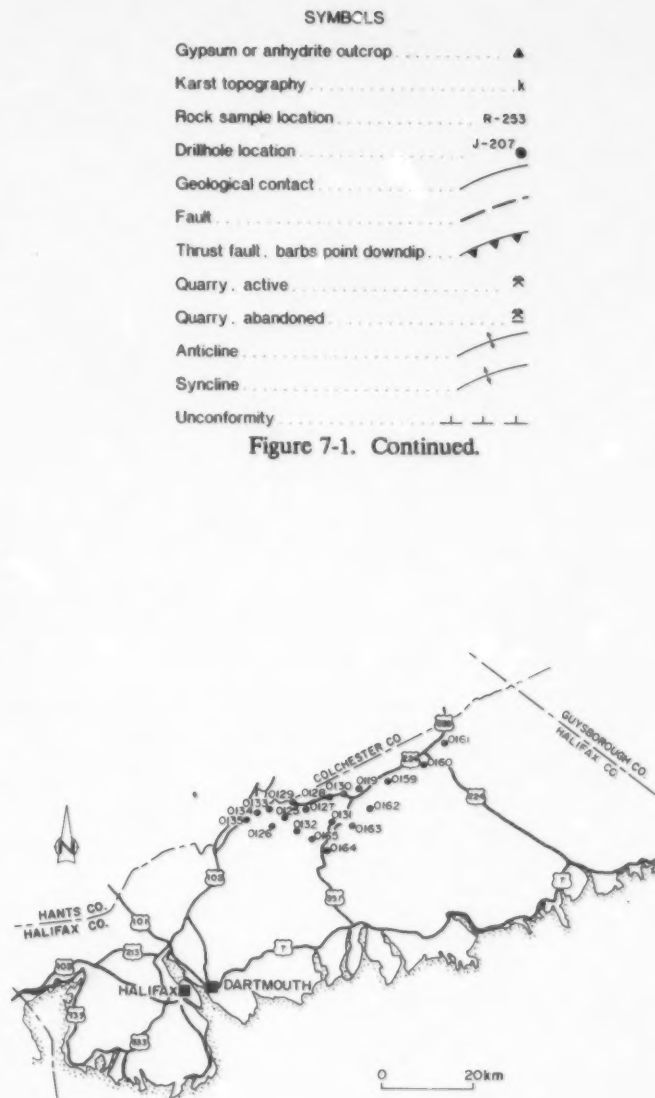


Figure 7-2. Location map for Halifax County gypsum and anhydrite occurrences by reference number.

ANNAND BROOK (0125)

NTS 11D/14C

UTM 472500 E 4982000 N

The Annand Brook occurrence area is located from 1-5 km southeast of the Village of Gays River, Colchester County (Fig. 7-3). It comprises numerous drillhole intersections, as well as an extensive area of karst topography and gypsum/anhydrite outcrop found between Annand Brook and Far Brook.

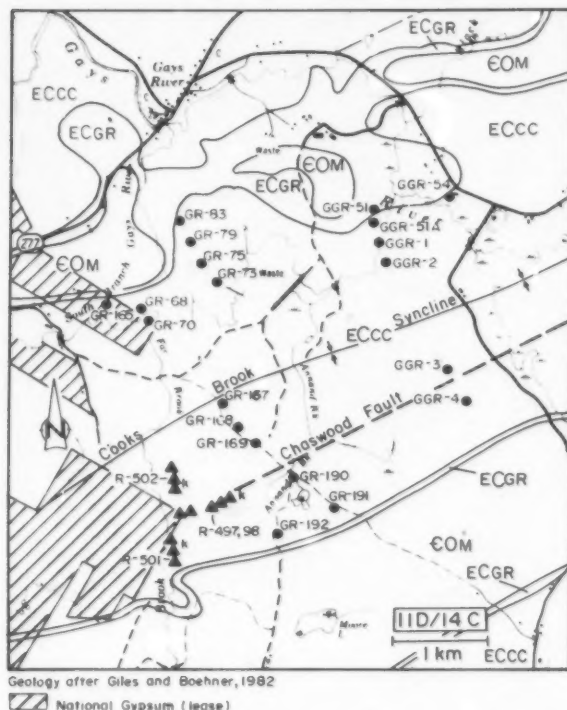


Figure 7-3. Location and geology of the Annand Brook occurrence area. See Figures 7-1 and 7-2 for legend and location.

Regional geological mapping by Giles and Boehner (1982) showed this area as being underlain by the Cycle 1 (A Subzone) Carrolls Corner Formation. This sulphate dominated unit is underlain by the Gays River Formation which overlies metamorphic rocks of the Cambro-Ordovician Meguma Group. The area straddles the Cocks Brook Syncline, a northeasterly trending limb of the Musquodoboit Basin.

At least 20 drillholes have been completed in this area by base metal exploration companies. During 1972-73, Imperial Oil Ltd. drilled 13 holes (Burton, 1974b), and Getty Mines Limited drilled another nine holes in 1973-74 (Comeau, 1973, 1974a). Most of these holes encountered the basal sulphate (Carrolls Corner

Formation) before passing through the Gays River Formation carbonate and stopping in the metamorphic basement rocks.

Approximately 40 ha of karst topography with numerous outcrops of gypsum and anhydrite can be found between Annand Brook in the east and Far Brook in the west. Karst ranges from light in the east to heavy along Far Brook where sinkholes range up to 25 m in diameter and 10 m in depth. Outcrops contain fine grained, massive, white gypsum overlying light grey to blue-grey, fine grained, massive anhydrite. Hydration ranges from 10- >15 m in height in outcrop.

In general, hydration appears to be typical (for Cycle 1 (A Subzone)) in this area, i.e. thickest along the Musquodoboit Basin's margins and thin over most of the area. Exceptions to this are seen in two drillholes, GGR-3 and GR-167, where a deeply hydrated upper portion of 'dirty gypsum' was described in company drillhole records (Burton, 1974b; Comeau, 1973). Hole GGR-3 contains 30.5 m of dirty gypsum with mud and anhydrite interbeds which is overlain by 36.9 m of overburden. In hole GR-167, 40.5 m of variably dirty gypsum was encountered under 16.8 m of overburden. This area is northeast, approximately along strike, of the karst and outcrop area seen east of Far Brook.

The Annand Brook area has good potential for possible gypsum/anhydrite resources. Excellent karst and surface exposure indications as well as drillhole intersections make this area worthy of further exploration.

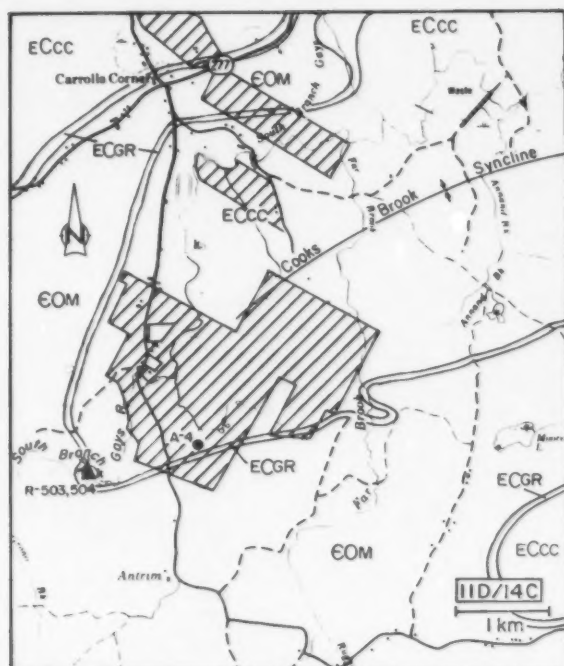
ANTRIM (0126)

NTS 11D/14C

UTM 468800 E 4980500 N

The Antrim occurrence area is located 3-5 km south of the Village of Gays River, Colchester County (Fig. 7-4). Two areas of karst topography, one with gypsum outcrops, and one diamond-drill hole comprise all of the information currently available on this area. National Gypsum Canada Ltd. has apparently drilled a number of holes in this area, however little of its information is available.

This area includes the western end of the Cocks Brook Syncline as determined by Giles and Boehner (1982). It extends from the Annand Brook occurrence area west to the end of the Syncline. Carrolls Corner Formation sulphates underlie the entire area and are underlain by the basal Windsor Group Gays River Formation. This in turn overlies the metamorphic rocks of the Meguma Group.



Geology after Giles and Boehner, 1982

▨ National Gypsum (lease)

Figure 7-4. Location and geology of the Antrim occurrence area. See Figures 7-1 and 7-2 for legend and location.

Rio Tinto Canadian Exploration Ltd. drilled one diamond-drill hole (A-4) near the southern margin of the basin at Antrim in 1973, as part of a regional base metal exploration program. It intersected 3 m of overburden, 12.2 m of light brown to white gypsum with increasing anhydrite towards the base, before passing into the massive basal anhydrite (Shewman, 1973b).

Several small areas of karst topography can be found in the area, along the western margin of the Cooks Brook Syncline. The only outcrop area found is at the southwestern end of the Syncline on the southern side of the South Branch Gays River. Numerous rounded exposures of fine- to medium-grained, white gypsum are found associated with moderate to heavy karst topography.

This area has good potential for smaller, high purity deposits along the basin margin especially where cross-cutting structures may enhance the depth of hydration in the basal anhydrite. Insufficient information is available at this time to determine the extent of surface hydration, however the thin overburden and moderate gypsum thickness in Rio Tinto Exploration's hole is encouraging for further work.

BLACK BROOK (0129)

NTS 11E/03B

UTM 475000 E 4987000 N

The Black Brook occurrence area is located 3 km northeast of the Village of Gays River, Colchester County (Fig. 7-5). During the early 1970s, this area was the subject of an intense drilling program by Imperial Oil Ltd. in the vicinity of the Gays River mine site. Over 50 drillholes were completed in the area, 20 of which have been used to assess the gypsum and anhydrite resources. Additionally, several gypsum outcrops and a small area of karst topography can be seen along Black Brook.



Geology after Giles and Boehner, 1982

Figure 7-5. Location and geology of the Black Brook occurrence area. See Figures 7-1 and 7-2 for legend and location.

Regional geological mapping by Giles and Boehner (1982) indicated that this area is a small, faulted extension running eastward off the Shubenacadie Basin. It abuts the Pine Grove occurrence area (0123), Colchester County, to the west. Much of the area is underlain, in descending order, by the sulphate dominated Carrolls Corner Formation, by the Gays River Formation and by the Cambro-Ordovician Meguma Group. The Black Brook area is situated in the typical solution trench setting which is well documented elsewhere in the Province (McKay Section (0056), Hants County; Ottawa Brook (0083), Victoria County).

Little potential exists in this area for exploitable gypsum reserves. Large volumes of anhydrite are found underlying a thin cap of gypsum, however this situation is commonplace in this portion of the Shubenacadie Basin.

UTM 491500 E 4985700 N

Figure 7-6. Location and geology of the Brookvale occurrence area. See Figures 7-1 and 7-2 for legend and location.

Thus far, no analysis of the gypsum found in the Brookvale area has been undertaken. Drill log descriptions indicated the gypsum encountered to be typical of that seen in some areas where the Carrolls Corner Formation has been moderately disturbed and now consists of variably impure, selenitic gypsum. This area shows good potential with its deep hydration and undeveloped land. The nearest shipping point would be Sheet Harbour which is approximately 60 km to the southeast. Additional drilling could readily determine the quality and extent of gypsum already encountered by Imperial's drilling. Areas having shallower overburden might also be found along strike.

UTM 469000 E 4985000 N

This area lies along the southeastern margin of the Shubenacadie Basin between the Pine Grove occurrence

area (0123), Colchester County, to the northeast and the East Milford mine site to the southwest. Regional geological mapping by Giles and Bochner (1982) showed the area as being underlain by the calcium sulphate dominated Carrolls Corner Formation which is overlain to the northwest by interbedded carbonates, calcium sulphates and clastics of the MacDonald Road Formation. The Carrolls Corner Formation overlies the basal Windsor Group Gays River Formation carbonate which forms local buildups around Meguma Group basement highs.

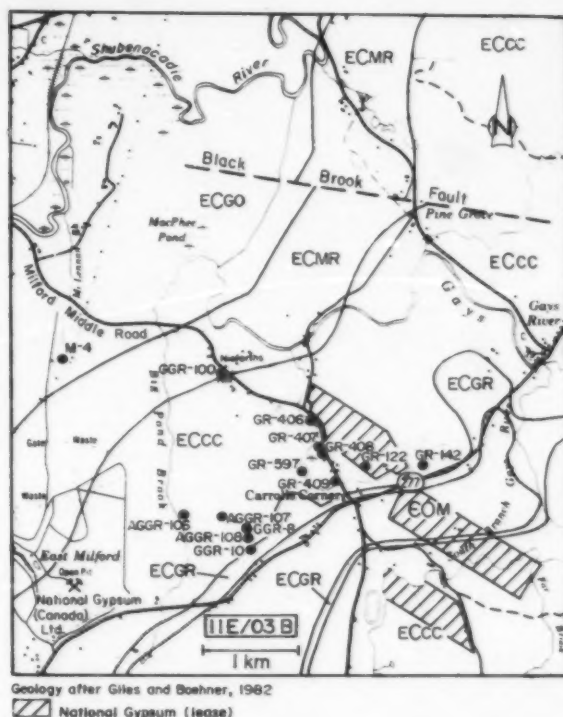


Figure 7-7. Location and geology of the Carrolls Corner occurrence area. See Figures 7-1 and 7-2 for legend and location.

One small sulphide base metal occurrence was reported within the area which probably led to further drilling in the vicinity (Burton, 1974b). At least 31 drillholes have been completed within the Carrolls Corner occurrence area (not all shown on map); all were drilled in the exploration for Gays River type base metal deposits during the early 1970s. Rio Tinto Canadian Exploration Ltd. (Shewman, 1973c) drilled one hole, M-4, 3 km northwest of Carrolls Corner. It encountered Upper Windsor Group clastics and was stopped before encountering any sulphate horizons. Getty Mines Limited drilled five holes in the area (Comeau, 1974-75) and Imperial Oil Limited drilled 25, all in search of base metal mineralization (Burton, 1974b).

Imperial's exploration drilling was concentrated along the Basin margin near the Milford Middle Road, consequently, most of its holes encountered erosionally thinned sections of basal anhydrite capped by thin gypsum horizons. Getty's holes were located further in the Basin and locally encountered the thick hydrated horizon at the boundary between the Carrolls Corner and MacDonald Road Formations which is mined at National's East Milford Quarry. Drillhole AGGR-106 encountered 73.2 m of dirty gypsum overlain by 3.0 m of overburden and hole GGR-100, drilled 1500 m to the north of AGGR-106, encountered 54.9 m of gypsum with clay and anhydrite overlain by 39.6 m of overburden. These sections, as described, resemble the highly disturbed, dark grey, selenitic gypsum mined at the East Milford Quarry.

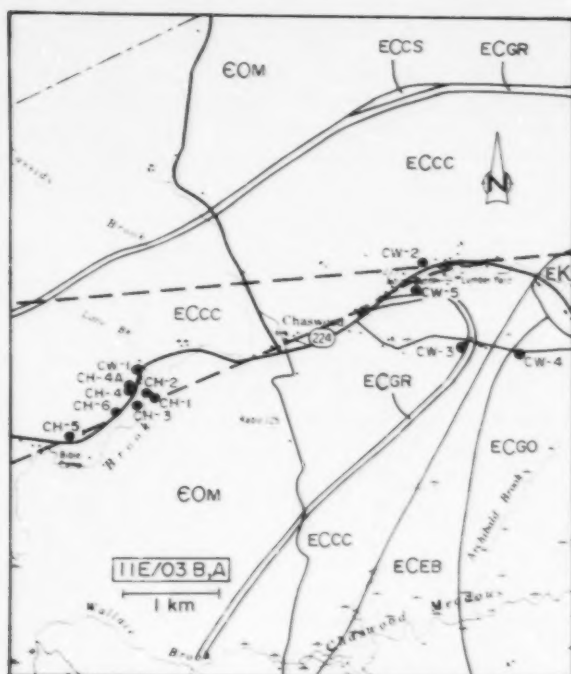
The Carrolls Corner occurrence area appears to contain an extension of National Gypsum's East Milford Quarry section. Should additional drilling establish this, then development potential would be excellent. Insufficient information is presently available to attempt to determine reserves in this area, although it is believed that they could be substantial.

CHASWOOD (0128)
NTS 11E/03B, 11E/03A
UTM 483000 E 4988000 N

The Chaswood occurrence area is found 5 km west of the Village of Middle Musquodoboit, Halifax County (Fig. 7-8). No surficial exposures of gypsum or anhydrite were found in this area, although some hummocky terrain may be attributable to underlying karst. All data available for the area are derived from drillhole information taken from base metal exploration programs.

The Chaswood area includes the eastern end of the Cooks Brook extension of the Musquodoboit Basin. It lies between the Cooks Brook occurrence area (0127) to the west and the Middle Musquodoboit occurrence area (0130) to the east. Much of this area is underlain by the sulphate-dominated Carrolls Corner Formation. Giles and Bochner (1982) indicated that two major faults run through the area. The sulphates are underlain by the basal Windsor Group Gays River Formation which are underlain by the metamorphics of the Meguma Group.

In 1973, Jorex/Imperial Oil Ltd. drilled five exploration holes (CH-2, -4, -4A, -5, -6) in this area which passed through or into the Windsor Group strata as part of a regional base metal exploration program (Johnston, 1973b). Millmor-Rogers Syndicate also drilled three holes (CW-1, -2, -5) within the Chaswood area that same year (Millmor-Rogers Syndicate, 1973).



Geology after Giles and Bochner, 1982

Figure 7-8. Location and geology of the Chaswood occurrence area. See Figures 7-1 and 7-2 for legend and location.

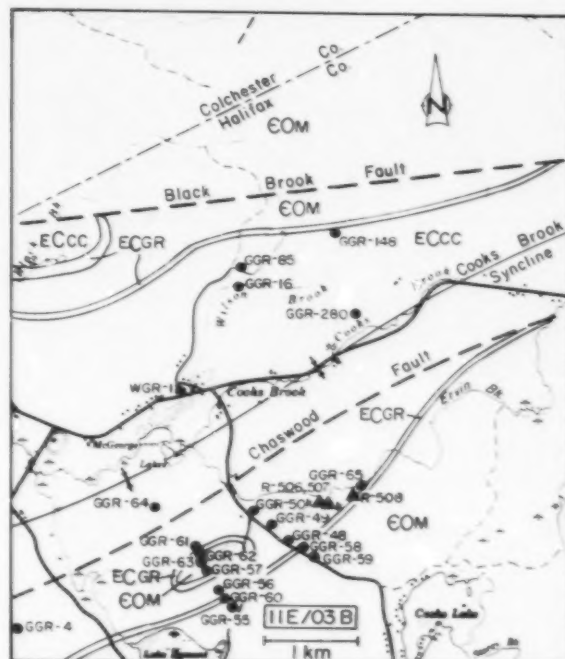
Logs of these drillholes indicate that in the area of the faults, hydration of the basal sulphate extends down to greater than normal depths. Hole CW-2 encountered 95.1 m of "grey gypsum with a few mud seams," under only 11 m of overburden (Millmor-Rogers Syndicate, 1973). Unfortunately the fault area along the southeastern edge of the Musquodoboit Basin is also deeply karsted and infilled to depths of 91.4 m below surface within a few hundred metres of the thick gypsum sections.

This area holds great potential for considerable reserves of gypsum provided the deep hydration noted in CW-2, CW-5 and CH-6 continues along the faults to the northern side of the Musquodoboit Basin. A small drilling program could readily establish whether this situation exists. The Chaswood area, although 65 km from the shipping facilities at Sheet Harbour, might be amenable to truck haulage.

COOKS BROOK (0127)
NTS 11E/03B
UTM 477900 E 4984400 N

The Cooks Brook occurrence area is located 5 km east of the Village of Gays River, Colchester County (Fig.

7-9). One small area of karst topography with minor outcrops can be found along the southwestern side of Ervin Brook. In addition, a total of 17 diamond-drill holes which have encountered the Windsor Group have been completed in this area.



Geology after Giles and Bochner, 1982

Figure 7-9. Location and geology of the Cooks Brook occurrence area. See Figures 7-1 and 7-2 for legend and location.

This occurrence straddles the Cooks Brook Syncline which runs northeast-southwest through the area. It abuts the Annand Brook occurrence area (0125) to the southwest and the Chaswood occurrence area (0128) to the northeast. Regional geological mapping by Giles and Bochner (1982) indicated that the entire area is underlain by the sulphate dominated Carrolls Corner Formation which is underlain by the Gays River Formation which in turn overlies the metamorphic rocks of the Meguma Group.

Between 1973 and 1975 Getty Mines Ltd. drilled 15 holes in the Cooks Brook area (Comeau, 1973, 1974-75); in 1973 Imperial Oil Limited (Hannon, 1974a) drilled one hole (GR-280); and in 1967 Sedco Exploration drilled one hole (WGR-1) (Nova Scotia Department of Mines, 1967a). The Basin appears to be somewhat shallower in this area than it is to the west in the Annand Brook area (0125) and a basement high parallels the southeastern margin of the Basin. Unfortunately

if either of these factors increased the local depth of hydration, those sections may have been eroded away and the depressions infilled by overburden materials.

The outcrop area along Ervin Brook consists of several small, rounded exposures of white to light brown, fine grained gypsum. Moderate to heavy karst topography can also be found in this area which parallels the Windsor-Meguma contact.

Development potential appears to be quite limited in the Cooks Brook area. Hydrated sections in the drilling are generally <15 m and usually covered by >15 m of overburden. Potential resources may exist along the contact between the Carrolls Corner and Gays River Formations and should be of high purity, but limited volume.

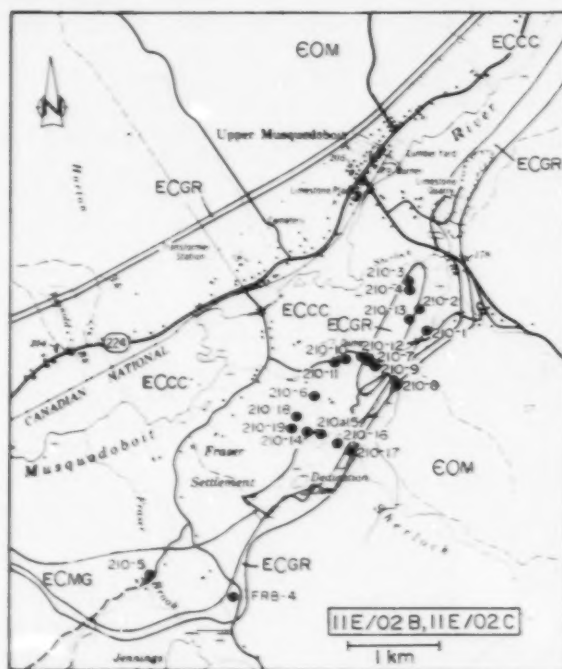
DEDICATION LAKE (0160)
NTS 11E/02B, 11E/02C
UTM 504000 E 4996000 N

The Dedication Lake occurrence area is located 2 km south of the Village of Upper Musquodoboit, Halifax County (Fig. 7-10). Karst topography or exposures of gypsum and anhydrite have not been noted in the area and all the information available for this occurrence is taken from drilling by Noranda Exploration Company Ltd.'s 1974-75 exploration program (Noranda Exploration Company Ltd., 1974; Nash, 1975a).

This area is situated in the northeastern part of the Musquodoboit Basin between the Elmsvale (0159) area to the southwest and the Upper Musquodoboit area (0161) to the northeast. Giles and Bochner (1982) indicated that much of this area is underlain by the sulphate-dominated Carrolls Corner Formation which is underlain to the south by interbedded clastics, carbonates and sulphates of the Meaghers Grant Formation and the basal carbonates of the Gays River Formation. These units generally strike northeast-southwest along the valley of the Musquodoboit River and are underlain by metamorphics of the Meguma Group.

Noranda drilled 19 holes in the area of a Gays River Formation carbonate buildup which occurs on the northern end of Dedication Lake along the southeastern side of the Musquodoboit Basin. No drilling was carried out along the northern side of the Basin within the occurrence area. Although hydration extends as deeply as 167.6 m below surface in the area (hole 210-11) two factors which would inhibit development are obvious from the drillhole information. First, much of the hydrated section of the Carrolls Corner Formation has been removed by erosion. As a result overburden and

karst infill material can be as thick as 57.9 m and commonly exceed 30.5 m. Secondly, this dissolution and infilling is also present at depth in drillholes where it has extended down dip to be noted as areas of poor recovery or unconsolidated material underneath competent gypsum units.



Geology after Giles and Bochner, 1982

Figure 7-10. Location and geology of the Dedication Lake occurrence area. See Figures 7-1 and 7-2 for legend and location.

The northern side of the Basin in this area may be underlain by units which have not undergone such extensive dissolution. However, residential development has occupied this portion of the valley and would prevent development. The Dedication Lake occurrence area is of geological interest only. Should these units be less eroded along strike to the northeast or southwest then they may have the potential for development.

DUTCH SETTLEMENT (0135)
NTS 11D/14C, 11E/03B
UTM 465000 E 4982500 N

The Dutch Settlement deposit area is situated southwest of the East Milford deposit area (0134) and National Gypsum (Canada) Ltd.'s mine site (Fig. 7-11). Much of the area is held by Fundy Gypsum Canada Ltd. who are presently proposing to develop the deposit in the near future under the name of the Nova Scotia Gypsum Company.

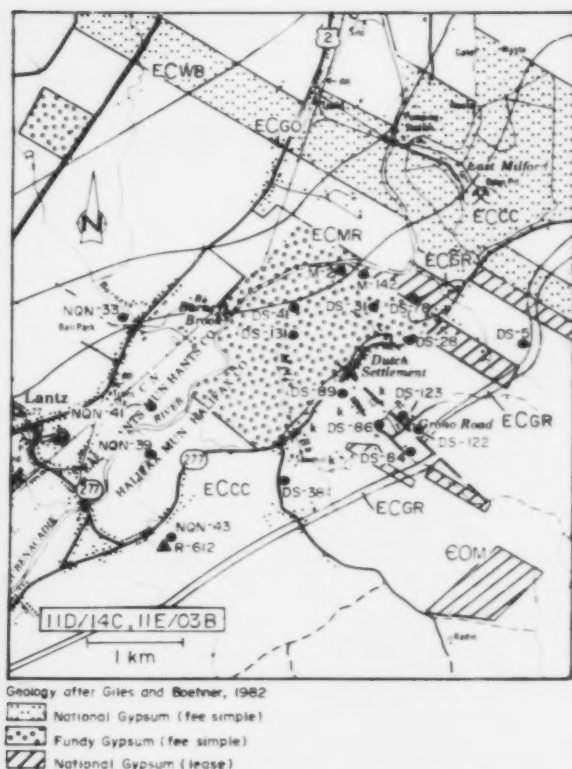


Figure 7-11. Location and geology of the Dutch Settlement occurrence area. See Figures 7-1 and 7-2 for legend and location.

Fundy acquired fee simple holdings as well as leases in this area during the early 1950s, about the same time as National began to develop the East Milford Quarry. Little work had been done on the property until the early 1980s when drilling programs were undertaken to delineate gypsum reserves in the area. Unfortunately, none of the company's information is available at this time. A number of base metal exploration drillholes, however, were put down in this area during the early 1970s by Amax Exploration Inc. and Rio Tinto Canadian Exploration Ltd. (Amax Exploration Inc., 1974c; Lebel, 1974b; Shewman, 1973c). Information from these drill logs is the only available data to describe the deposit.

The Dutch Settlement area lies along the south-eastern flank of the Shubenacadie Basin (Giles and Bochner, 1982) which trends roughly northwesterly through the area. Most of the area is underlain by the Cycle 1 (A Subzone) sulphate-dominated Carrolls Corner Formation which is underlain by the basal Windsor Group Gays River carbonate to the southeast. Similar to the East Milford deposit, the Carrolls Corner

Formation is overlain to the northwest by the interbedded carbonates, clastics and sulphates of the MacDonald Road Formation. A pronounced basement high approximately 150 m in width with carbonate buildup with associated base metal deposits, similar to the Gays River lead/zinc deposit, runs approximately northeast-southwest through this area, slightly north of Route 277, over a distance of 2000 m at the north-western end of the area. This feature was extensively drilled by Amax Exploration Inc. (1974c) and may extend further to the southwest, however insufficient drillhole information is available to delineate it further.

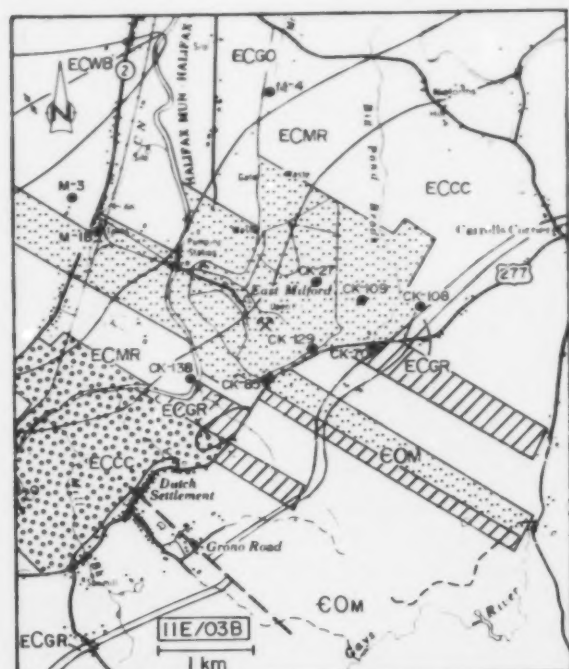
More than 37 holes were drilled in this area, one by Rio Tinto (M-2) (Shewman, 1973c), the rest by Amax between 1973 and 1975. Most of these holes are concentrated around the basement high, the rest are scattered through the area. As at East Milford, the thick gypsiferous section appears to occur in a highly disrupted horizon at or near the base of the Cycle 2 (B Subzone) of the Windsor Group. The hydrated section varies from 30-90 m in thickness with abundant (10-30%) intermixed clay and carbonate material. Overburden also varies between 5 and 15 m in thickness and probably averages 10 m in thickness. Hydration appears to thin over the basement highs, however these are coincident with inhabited areas making development impossible.

Gypsum reserves in the Dutch Settlement area, located between Route 277 and the Shubenacadie River on property held by Fundy Gypsum could exceed 50 Mt depending on cultural and mining constraints. Additional reserves are located east of Route 277 towards the Basin margin, however residential development is rapidly encroaching in this karst area with ground of questionable stability. The hydrated section gradually thickens to the west and northwest away from the basement high. The thickest section is in hole DS-131 where 103.6 m of dark grey gypsum with minor intermixed clays is overlain by 9.1 m of overburden (Roth and Lebel, 1975a).

Geologically, the Dutch Settlement area is very similar to the East Milford deposit and appears to have excellent potential reserves of quarriable gypsum. Much additional information is required to more accurately assess the quantity and quality of the gypsum identified in the area. One major concern in this area which might hinder future development by Fundy Gypsum is the rapid residential development of the surrounding area. Resource sterilization in this area as well as in the northeastern continuation of the potential mining zone toward Carrolls Corner is a significant concern.

EAST MILFORD (0134)
NTS 11E/03B
UTM 467000 E 4984000 N

Gypsum has been produced at the East Milford site by National Gypsum (Canada) Ltd. since 1955 (Fig. 7-12). Exploration began on the site in July 1951 and by the fall of 1953 a decision had been made to develop the deposit. This project consolidated National's operations in the Province by replacing its production from sites at Walton (0179), Hants County, and Dingwall (0048), Victoria County. Quarry facilities at East Milford and load-out facilities at Wrights Cove on Bedford Basin were operational by 1955 (Nova Scotia Department of Mines, 1955).



Geology after Giles and Boehner, 1982

- National Gypsum (fee simple)
- Fundy Gypsum (fee simple)
- National Gypsum (lease)

Figure 7-12. Location and geology of the East Milford occurrence area. See Figures 7-1 and 7-2 for legend and location.

Between 1955 and 1987 a total of 64 644 677 t were produced at the East Milford Quarry (total from Nova Scotia Department of Mines and Energy, Annual Reports, 1956-1988). It is believed to be the most productive open-pit gypsum mine in the western world. Gypsum from the Quarry is shipped by rail 42 km to load-out facilities on Bedford Basin. Ocean-going vessels transport the material to markets in Central

Canada and the Eastern United States from Portsmouth, New Hampshire, to New Orleans, Louisiana (Fowler and Adams, 1988).

The East Milford deposit appears to occur in a highly disrupted horizon at or near the base of the Cycle 2 (B Subzone), of the Windsor Group. Within the Quarry section, which ranges from 50-90 m in thickness, recognizable interbeds of carbonates or clastics cannot be traced over even short distances. Waste materials, which are removed from the quarried material by screening after it is crushed, are believed to comprise +25% of the total. This figure is approximately equal to the amount of interbedded material which is mass-wasted in Lower Cycle 2 (B Subzone) quarries operated at Miller Creek (0183), Hants County, and Little Narrows (0087), Victoria County. A unique explanation for this greater degree of structural disturbance at East Milford has not yet been determined, however, as at other sites, it appears to have been the mechanism which allowed hydration of the sulphate horizons to such great depths below present day surfaces.

The Quarry section is underlain by the massive anhydrite of the Cycle 1 (A Subzone) which thins towards the Shubenacadie Basin margin to the southeast. The anhydrite is underlain by thin basal carbonate of the Gays River Formation which locally form mounds on basement highs at or near the Basin margin. Meguma Group metamorphic rocks underlie the Gays River carbonates. The Cycle 2 (B Subzone) MacDonald Road Formation is overlain to the northwest by interbedded clastics, carbonates and minor sulphates of the Upper Windsor Green Oaks Formation (Giles and Boehner, 1982).

Unfortunately, due to the highly disturbed nature of the Quarry section, detailed examination and interpretation of the stratigraphy is virtually impossible. The only academic study undertaken thus far in this vicinity was a B.Sc. thesis by Colin McKenzie at Dalhousie University (1971). His study area was located 1500 m along strike to the southwest of the East Milford Quarry on an area being investigated by the Fundy Gypsum Company Ltd. (Dutch Settlement occurrence 0135). McKenzie (1971) was unable to carry out stratigraphic correlations using Fundy's drillcores due to "a combination of rapid and profound facies changes, complex structural and technical problems ..." (McKenzie, 1971, p. 16).

One possible mechanism which could produce this apparently highly disturbed Cycle 2 (B Subzone) section overlying the undeformed basal sulphate of Cycle 1 (A Subzone) would be gravity sliding (Moore, personal

communication in McKenzie, 1971). Similar geological sections, mined at Miller Creek, Hants County, and Little Narrows, Victoria County, are folded and faulted, but not as deformed as that seen at East Milford. Boehner (in press) reinforces this idea that more mobile, salt-bearing strata of the Upper Cycle 1 (A Subzone) Stewiacke Formation and lower part of the Cycle 2 (B Subzone) MacDonald Road Formation are most susceptible to decollement type deformation. The concentration of highly soluble salt seen at the top of Cycle 1 and lower part of Cycle 2 further contributes to an enhanced plumbing system (hydration) due to fault-fracturing and solution collapse in near surface (above 300 m depth) environments. This results in a greater degree of deformation in the less competent strata as seen at East Milford than in those units observed stratigraphically both above and below.

Whatever the mechanism, the Quarry section at East Milford appears to represent a highly disturbed portion of the Lower Cycle 2 (B Subzone) confined between an otherwise undisturbed stratigraphic section of the rest of the MacDonald Road Formation and the underlying Carrolls Corner Formation. This zone appears to extend northeast-southwest along the Cycle 1/Cycle 2 contact parallel to the Basin margin.

National Gypsum carried out exploration drilling programs in recent years on areas adjacent to the Quarry site, and, although incomplete, it appears that the Quarry section extends along a northeasterly trend both north and south away from the Quarry. In addition, some reserves have also been found of higher purity surface hydrated Cycle 1 (A Subzone) gypsum towards the Basin margin. A few base metal exploration drill-holes in the area around the Quarry substantiate National's results (Amax Exploration Inc., 1974f; Burton, 1974b; Hannon, 1973a, b).

With drill indicated minable sections between 50-90 m thick continuing to the northeast on National's property and minimal overburden of 7.2 m over the same area, the future of the operation appears quite good for at least 10-15 years. Further work will have to be carried out to increase its reserves, however all indications appear to be positive.

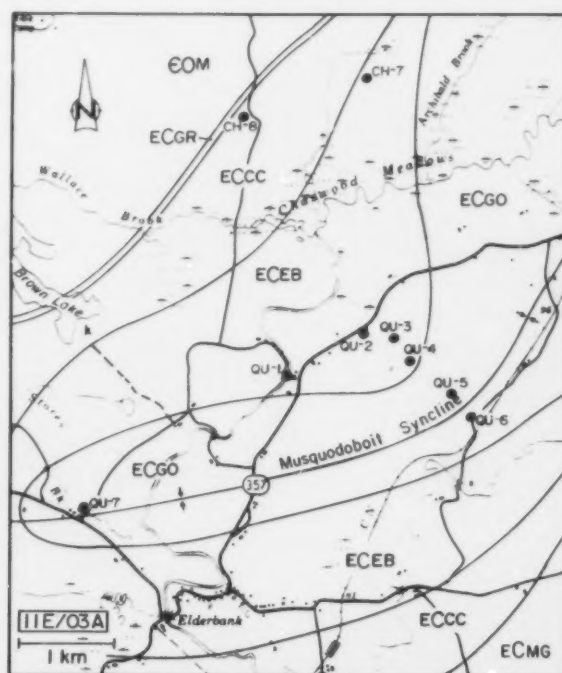
Huge reserves of high purity anhydrite exist at East Milford beneath the gypsiferous horizon. Thus far, National has used only a limited volume of anhydrite on its site for road building purposes. The potential exists for National to sell anhydrite to some of its cement industry customers in the future.

ELDERBANK (0131)

NTS 11E/03A

UTM 484500 E 4983000 N

The Elderbank occurrence area is located 6 km southwest of the Village of Middle Musquodoboit, Halifax County (Fig. 7-13). Some evidence of karst topography can be seen at the southern end of Brown Lake, however the only gypsum and anhydrite observed in this area is found in drillholes. Nine drillholes were completed in this vicinity in 1973; two by Jorex Ltd. failed to reach bedrock (Johnston, 1973b) and seven drilled by Quebec Uranium Mining Corp., all encountered sulphate horizons beneath the Elderbank Formation (Hannon, 1973c).



Geology after Giles and Boehner, 1982

Figure 7-13. Location and geology of the Elderbank occurrence area. See Figures 7-1 and 7-2 for legend and location.

This occurrence area encompasses the northwestern side of the Musquodoboit Syncline between Middle Musquodoboit and Elderbank. Much of the area was mapped by Giles and Boehner (1982) as being underlain by the interbedded clastics, carbonates and minor sulphates of the Green Oaks and Elderbank Formations which overlie the sulphate-dominated Carrolls Corner Formation. This is underlain by the carbonate dominated Gays River or Meaghers Grant Formation which

usually overlies either Horton Group clastics or Meguma Group metamorphic rocks.

The Jorex holes were drilled close to the Musquodoboit Basin margin and encountered thick Pleistocene and Cretaceous sequences (67 and 94 m for CH-8 and CH-7, respectively). This indicates deep dissolution and dissection of the sulphates in this area (Johnston, 1973b) and may explain the lack of karst topography. The seven Quebec Uranium holes (QU-1 to QU-7) were drilled in the middle of the Basin and all penetrated the top of the Carrolls Corner Formation (Hannon, 1973c). Sulphate horizons encountered were generally described as gypsum or anhydrite mixed with varying amounts of silt or carbonate material. These sections are +100 m below surface.

Little opportunity exists for development of the gypsum encountered at depth in the Elderbank area. Although minimal information is available along the Basin margin, the lack of karst topography and outcrop suggests that the sulphates present are deeply eroded and infilled. The Brown Lake area along the southern side of the Chaswood ridge may warrant some further investigation.

ELMSVALE (0159)

NTS 11E/03A

UTM 495000 E 4992000 N

The Elmsvale occurrence area is located 7 km northeast of the Village of Middle Musquodoboit, Halifax County (Fig. 7-14). Drillhole information from exploration work carried out by Imperial Oil Ltd. in 1973-74 (V. Hannon, 1973; P. J. Hannon, 1974b) and by Noranda Exploration Company in 1974 (Nash, 1975b) showed interesting intersections of gypsum and anhydrite in this area.

The occurrence area is located on the northern side of the Musquodoboit Basin. Giles and Boehner (1982) indicate that the area is underlain by a section of the Lower Windsor Group including the interbedded clastics, carbonates and minor sulphates of the Elderbank Formation which overlies the sulphate dominated Carrolls Corner Formation. Along the southeastern side of the Basin, the Meaghers Grant Formation underlies the Carrolls Corner Formation. The basal unit of the Windsor Group in this area is the Gays River Formation which underlies both the Meaghers Grant Formation and the Carrolls Corner Formation and rests upon either clastics of the Horton Group or Meguma Group metamorphics.

Unlike other areas in the Province, in the Musquodoboit Basin the thick sulphates of the Carrolls

Corner Formation are described as containing large amounts of intermixed clastic and carbonate material (up to 50%). As a result, it is difficult to evaluate this area for development potential since none of the cores have ever been tested for gypsum or anhydrite quality. Drillholes in the Carrolls Corner Formation, on both sides of the Basin in this area, however, encountered deeply hydrated sections, i.e. 93.3 m of "mixed gypsum and silt" under 29.9 m of overburden in hole B-4 and 75.6 m of "gypsum with calcareous mud seams" under 17.1 m of overburden in hole 209-3 (Hannon, 1973).

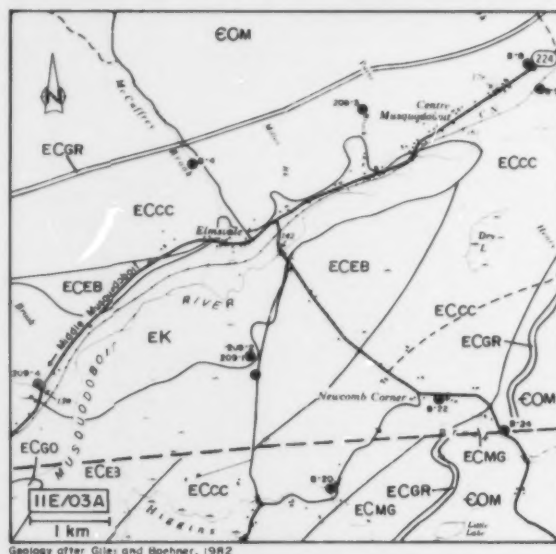


Figure 7-14. Location and geology of the Elmsvale occurrence area. See Figures 7-1 and 7-2 for legend and location.

The Elmsvale area has good potential for gypsum and should be drilled in order to establish the quality and quantity of the gypsum and anhydrite. If sufficient material were present in the area to warrant development, then the nearest shipping facility would be located at Sheet Harbour, 55 km to the southwest.

GLENMORE (0119)

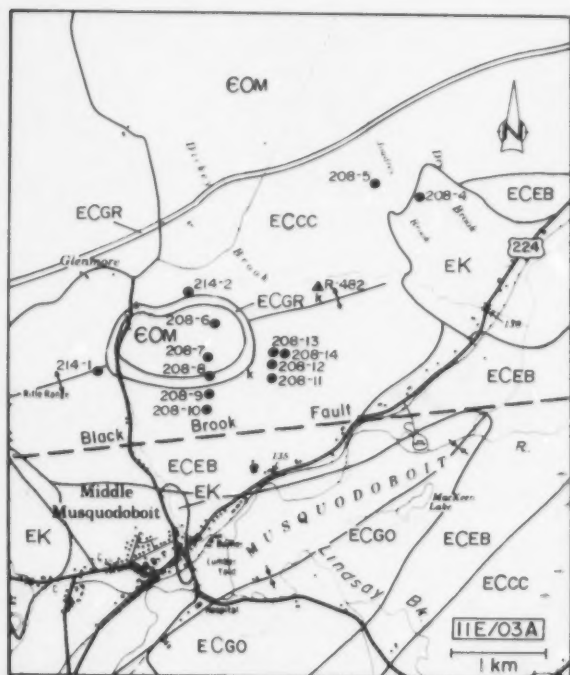
NTS 11E/03A

UTM 489650 E 4989700 N

The Glenmore occurrence area is located 1.5 km northeast of the Village of Middle Musquodoboit, Halifax County (Fig. 7-15). Although a small area of rounded outcroppings and karst topography can be found south of Dickey Brook, most of the information available comes from drillhole data.

Regional geological mapping by Giles and Boehner (1982) indicated that the Glenmore area is underlain by

a basement (Meguma Group) high surrounded by units of the basal Windsor Group Gays River and Carrolls Corner Formations. The margin of the Windsor Basin lies just to the north of this area, striking northeast-southwest and deepening rapidly to the south of the area where it is overlain by Upper Windsor units. Thick sand and clay units of Cretaceous age can be found along strike from the area both to the northeast and southwest.



Geology after Giles and Boehner, 1982

Figure 7-15. Location and geology of the Glenmore occurrence area. See Figures 7-1 and 7-2 for legend and location.

A small area of karst topography with small gypsum outcrops can be found just south of Dickey Brook, 2 km upstream west-northwest of Route 224. The gypsum seen here is light greyish brown, fine grained, with minor to trace amounts of interlaminated dark grey siltstone. A total of 13 diamond-drill holes were completed in the area by Noranda Exploration Company Ltd. in 1974-75 (Nash, 1975b; Leahey, 1976) as part of a regional basement exploration program.

Thick sulphate horizons (up to 100 m) were found throughout much of this area. Unfortunately the drill logs filed by Noranda generally refer to these horizons as 'gypsum/anhydrite' and therefore it is impossible to determine the depth of hydration in most holes (Nash, 1975b; Leahey, 1976). Some of this core is still available (208-4 to 208-14 at Nova Scotia Department of Natural

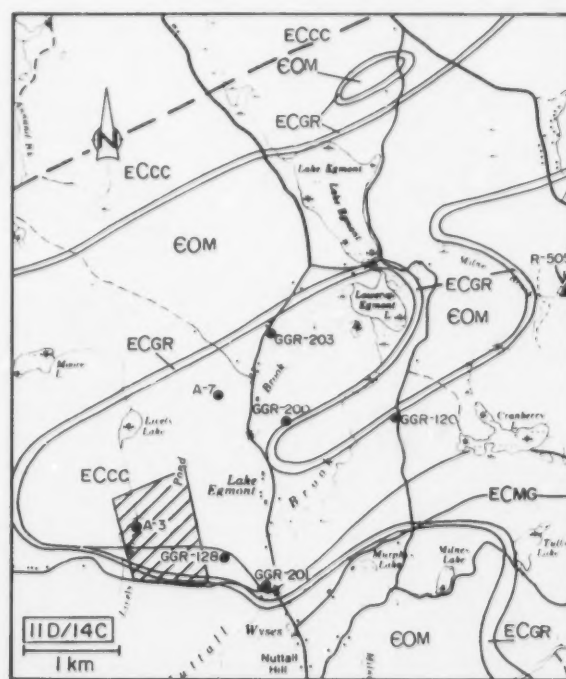
Resources, Core Library in Debert) and should be looked at to help evaluate the area. Overburden cover can be quite thick here, but is generally 10-20 m.

This area warrants much additional work considering the known sulphates and their potential for deeper hydration at the basal contact both along the Basin margin and around the basement high. This area is located approximately 65 km northwest of Sheet Harbour which is a potential shipping point.

LAKE EGMONT (0132)
NTS 11D/14C
UTM 547500 E 4980000 N

The Lake Egmont occurrence is located 7 km southwest of the Village of Gays River, Colchester County (Fig. 7-16). Scattered sinkholes are found in the Cranberry Lake area and several small rounded exposures of fine grained, white gypsum are located near the head of Milne Brook in the northeastern portion of the area.

This area includes a small westward extension of the Musquodoboit Basin northwest of the Meaghers Grant area (0164). Giles and Boehner (1982) mapped this area as being underlain by the sulphate dominated Carrolls



Geology after Giles and Boehner, 1982

▨ National Gypsum (lease)

Figure 7-16. Location and geology of the Lake Egmont occurrence area. See Figures 7-1 and 7-2 for legend and location.

Corner Formation. This is underlain to the north and west by the Gays River Formation and to the south by the interbedded clastics, carbonates and sulphates of the Meaghers Grant Formation.

Seven drillholes are located in the area. Rio Tinto Canadian Exploration Ltd. drilled two holes in 1973 (A-3, A-7) (Shewman, 1973b) and Getty Mines Ltd. drilled five more into the Windsor Group in 1975 (GGR-120, -128, -200, -201, -203) (Getty Mines Ltd., 1975). In general, the overburden is thick (+24 m) and the depth of hydration of the basal anhydrite is shallow. Although the drillholes available are insufficient to accurately assess the potential of the area, it does not appear to be very promising. The vicinity around the surface exposure on Milne Brook, however, is moderately to heavily karsted over a small area and might warrant some additional work.

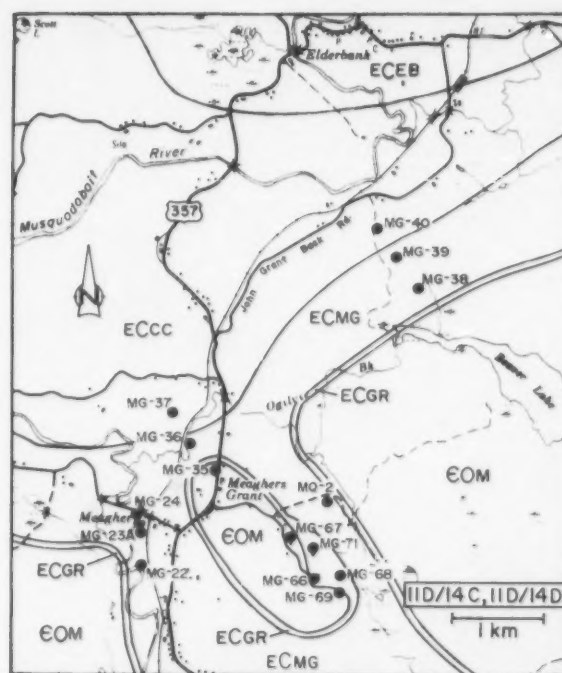
MEAGHERS GRANT (0164)

NTS 11D/14C, 11D/14D
UTM 482000 E 4978000 N

Located 15 km south-southwest of the Village of Middle Musquodoboit, Halifax County, the Meaghers Grant occurrence area includes the eastern portion of the southwestern end of the Musquodoboit Basin (Fig. 7-17). Outcrop exposures or karst topography are not evident within this area, however a large number of diamond-drill holes put down by Getty Mines Limited in 1973-1975 provide the basic information on the gypsum and anhydrite units in the subsurface (Comeau, 1974b; Bochner, personal communication).

Giles and Bochner (1982) indicated that much of this area is underlain by units of the sulphate-rich Carrolls Corner Formation and the underlying interbedded clastics, carbonates and sulphates of the Meaghers Grant Formation which strike northeast-southwest. This area is underlain to the south and southeast by the basal carbonate Gays River Formation which rests upon Meguma Group metamorphics. Basinward, to the north, the Carrolls Corner is overlain by the interbedded clastics, carbonates and sulphates of the Elderbank Formation.

Only two of Getty's drillholes in the area collared in the Carrolls Corner Formation, MG-37 and MG-40. Hole MG-40 encountered 57.9 m of dark grey, dolomitic gypsum overlain by 28.3 m of overburden and hole MG-37 passed through 29.3 m of selenitic gypsum with minor interbedded and intermixed clastics under 19.5 m of overburden (Comeau, 1974b).



Geology modified after Giles and Bochner, 1982

Figure 7-17. Location and geology of the Meaghers Grant occurrence area. See Figures 7-1 and 7-2 for legend and location.

No evaluation of the gypsum has yet been made, however the area warrants additional drillholes around the John Grant Back Road. As is the case along much of the southeastern margin of the Musquodoboit Basin, favourable geology and depth of hydration combined with the lack of rural settlement make it an attractive site for potential development. Shipping possibilities would be limited to the Sheet Harbour facility, located 70 km to the southeast either north via Upper Musquodoboit or south via Musquodoboit Harbour.

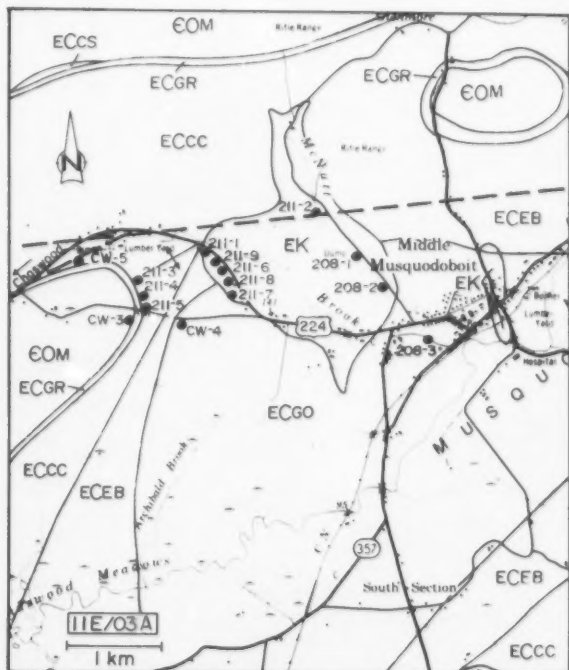
MIDDLE MUSQUODOBOIT (0130)

NTS 11E/03A
UTM 486500 E 4987500 N

The Middle Musquodoboit occurrence area includes the area of the Village of Middle Musquodoboit, Halifax County, and west towards Chaswood (Fig. 7-18). Although some hummocky terrain is noted in this area, no surface occurrences have been located to date. A total of 15 diamond-drill holes were completed in this area in 1973-74 as part of regional base metal exploration programs (Millmor-Rogers Syndicate, 1973; Nash, 1974). The occurrence area includes the northwestern side of the Musquodoboit Basin between the Glenmore

occurrence area (0119) to the northeast and the Elderbank occurrence area (0131) to the southwest.

Regional mapping by Giles and Bochner (1982) indicated that much of this area is covered by a thick layer of Cretaceous material. This is underlain by interbedded clastics and carbonates of the Green Oaks and Elderbank Formations (Major Cycles 2-4) which overlie the sulphate dominated Carrolls Corner Formation. The basal Windsor Group Gays River carbonate underlies these sulphates and lies upon either Horton Group clastics or Meguma Group metamorphic rocks.



Geology after Giles and Bochner, 1982

Figure 7-18. Location and geology of the Middle Musquodoboit occurrence area. See Figures 7-1 and 7-2 for legend and location.

Millmor-Rogers Syndicate drilled three holes in 1973 (CW-3, -4, -5) (Millmor-Rogers Syndicate, 1973) and Noranda Exploration Company Ltd. drilled 12 holes in 1973 and 1974 within this area (Nash, 1974). Three holes (211-3, -4 and -5) encountered significant thicknesses of gypsum (+20 m) near the Meguma-Windsor contact. Unfortunately, these are covered by even greater thicknesses of overburden. Farther out in the Basin three holes penetrated thick hydrated sections of the same gypsum horizon, Cycle 1 (A Subzone) Carrolls Corner at depth. The top 43 m from 177-205 m of the basal anhydrite was described as gypsum in hole 208-3 (Nash, 1974).

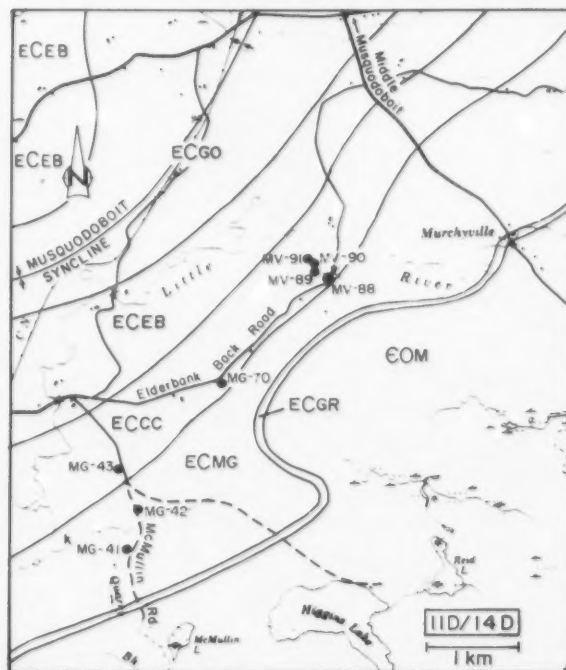
Drilling to date indicates good potential for significant tonnages of gypsum at depth in the Middle Musquodoboit area, however much additional work would be required to prove up resources. Unfortunately, at this time, there is little interest in deeply buried gypsum deposits distant from shipping points in Nova Scotia. Therefore, this area is of more geological than economic interest.

MURCHYVILLE (0163)

NTS 11D/14D

UTM 484500 E 4979300 N

The Murchville occurrence area is located 6 km south of the Village of Middle Musquodoboit, Halifax County (Fig. 7-19). Situated along the southeastern margin of



Geology after Giles and Bochner, 1982

Figure 7-19. Location and geology of the Murchville occurrence area. See Figures 7-1 and 7-2 for legend and location.

the Musquodoboit Basin, this area lies between the Brookvale area (0162) to the northeast and the Meaghers Grant area (0164) to the southwest. Some probable karst topography occurs in the area of Quarry Brook west of McMullin Road and along the Little River northwest of Elderbank Back Road. No outcrops were found in the area, however access was not obtained to the Quarry Brook area where Faribault (1907) noted the presence of a small gypsum quarry. Information is also available from a series of exploration drillholes completed by Getty Mines Limited in 1974-76 (Comeau,

1974b; Boehner, personal communication) as well as four short holes by the Nova Scotia Department of Mines in 1968 as part of the clay and shale project (Wright, 1969a, b).

Regional geological mapping by Giles and Boehner (1982) showed much of this area to be underlain by the sulphate-dominated Carrolls Corner Formation which strikes northeast-southwest through the area and is overlain to the northwest by the interbedded sulphates, carbonates and clastics of the Elderbank and Green Oaks Formations. The interbedded clastics, carbonates and sulphates of the Meaghers Grant Formation underlie the Carrolls Corner Formation to the southeast. These are in turn underlain by the basal Gays River Formation carbonate and subsequently by metamorphic rocks of the Meguma Group.

Two of Getty's drillholes (MG-43 and -70) and all four of Wright's holes (MV-88 to -91) appear to have collared in the Carrolls Corner Formation. Although the descriptive log of hole MG-70 does not distinguish gypsum and anhydrite, it is believed to be similar to hole MG-43 (1400 m to the southwest) in which 42.2 m of dark grey, selenitic gypsum was encountered beneath 15.8 m of overburden. Hole MG-70 was described as having 36.6 m of evaporites overlain by 14.3 m of overburden.

Unfortunately, analysis of the gypsum from this area has not been carried out to date. The sections in the available drilling appear to be very encouraging. In addition the area itself is undeveloped and would probably be amenable to mining. Additional work needs to be done in this area to determine the depth and lateral extent of hydration of the Carrolls Corner Formation sulphates. Should sufficient resources be available then possible shipments could be made via the facilities at Sheet Harbour located 65 km to the south-east.

UPPER MUSQUODOBOIT (0161)
NTS 11E/02C
UTM 507800 E 5000700 N

Located 4.5 km northwest of the Village of Upper Musquodoboit, Halifax County, this occurrence area includes the northeastern end of the Musquodoboit Basin (Fig. 7-20). Karst topography and gypsum outcrops can be found on both sides of the Musquodoboit River at this locale and in two exploration diamond-drill holes put down by George Logan (Boehner, personal communication).

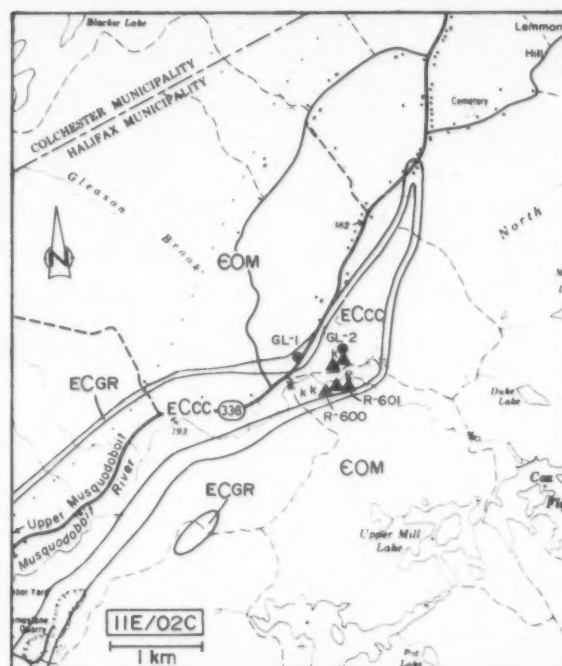


Figure 7-20. Location and geology of the Upper Musquodoboit occurrence area. See Figures 7-1 and 7-2 for legend and location.

Regional mapping by Giles and Boehner (1982) showed the area as being underlain by the sulphates of the Carrolls Corner Formation which are underlain by the Gays River Formation carbonates and the Meguma Group metamorphic rocks. The Windsor Group units trend northeast-southwest with the Basin ending to the northeast. Hydration of the basal anhydrite down both northern and southern edges of the Basin has left several blocks of high purity, fine grained, white gypsum with minor intermixed carbonate in this area.

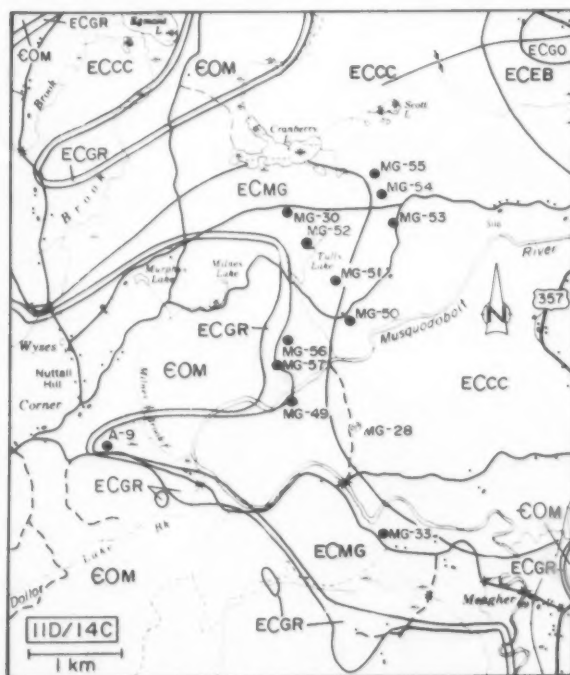
Two drillholes by Logan in the mid 1970s are useful in defining the basal sulphate in this area (125.6 m in GL-2) (Boehner, personal communication). Description of the gypsum portion of the core is vague and it is not clear how deeply the anhydrite may be hydrated, however recent excavations by Mosher Limestone of an exposure on the northern side of the Musquodoboit River indicates it should extend >10 m below surface. This exposure is located at least 200 m southeast of the contact between the Carrolls Corner and Gays River Formations.

Although probably limited in size the quality of gypsum and anhydrite and its location away from

developed areas give the Upper Musquodoboit area good development potential. Mosher Limestone has already taken some stone out for use as agricultural grade gypsum, a market which has the potential for expansion. Additional drilling is required to further determine depths of hydration and dissolution in the area which would greatly affect the potential tonnages. Possible shipping facilities are available at Sheet Harbour about 50 km to the southeast.

WYSES CORNER (0165)
NTS 11D/14C
UTM 479000 E 4979000 N

The Wyse Corner occurrence area is located 15 km south-southwest of the Village of Middle Musquodoboit, Halifax County, at the southwestern end of the Musquodoboit Basin (Fig. 7-21). It lies between the



Geology after Giles and Bochner, 1982

Figure 7-21. Location and geology of the Wyse Corner occurrence area. See Figures 7-1 and 7-2 for legend and location.

Meaghers Grant occurrence area (0164) to the southeast and the Lake Egmont occurrence area (0132) to the northwest. A number of small lakes found within this area may be the result of karstification, however no obvious karst topography was noted and no outcrops of gypsum or anhydrite were found. Virtually all of the

information available for the Wyse Corner area is taken from drillhole information gathered by Getty Mines Limited (Comeau, 1974b; Bochner, personal communication) and Rio Tinto Canadian Exploration Ltd. (Shewman, 1973b) during the early 1970s.

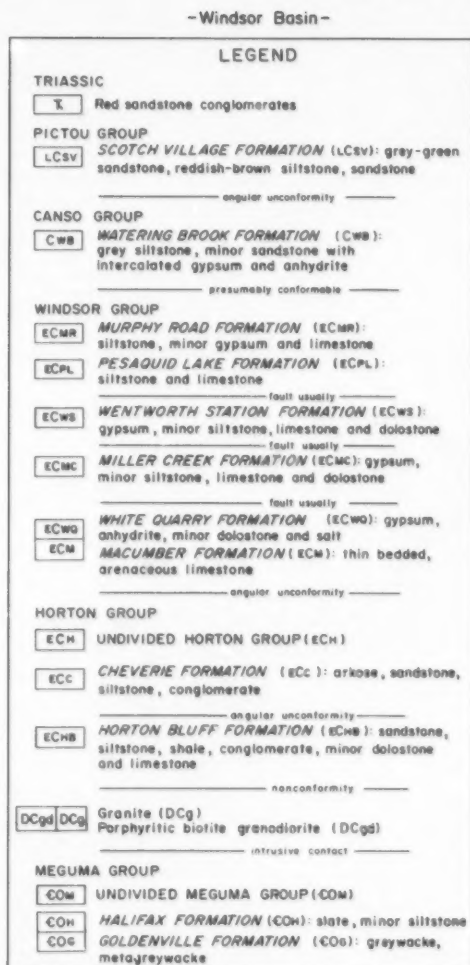
Geological mapping by Giles and Bochner (1982) indicated that much of this area is underlain by the sulphate-dominated Carrolls Corner Formation which is overlain to the north by the interbedded sulphates, carbonates and clastics of the Elderbank Formation. Intercalated with and underlying the Carrolls Corner are the interbedded clastics, sulphates and carbonates of the Meaghers Grant Formation which are underlain by the basal Windsor Group Gays River Formation carbonate which is underlain by metamorphics of the Meguma Group.

The Musquodoboit Basin margin is quite irregular in the Wyse Corner area, possibly reflecting an irregular basement paleotopography. Consequently, the contact between the Meaghers Grant and Carrolls Corner Formations is also very irregular. This irregularity and related facies variations causes difficulties in assessing the area's gypsum/anhydrite potential using the limited drillhole data that are available. Some drillholes collared near the Basin margin in the Meaghers Grant Formation appear to have encountered sections containing few interbeds of carbonate or clastic materials in the basal sulphate (i.e. MG-49, -51, -52 and A-9). These sections resemble those typical of the base of the Carrolls Corner Formation, but do not correspond with the typical Meaghers Grant section (Bochner, 1977b).

Several interesting gypsum sections have been described in drillholes in the area. Getty holes MG-49, -52, -53, -56 and -57 all encountered >26.5 m of gypsum. The thickest hydrated section was encountered in hole MG-50 where 46.6 m of white-grey to grey-brown gypsum was overlain by 30 m of overburden. The thinnest overburden was seen in hole MG-53 where 29.9 m of variably dolomitic gypsum was found underneath 17.4 m of overburden (Comeau, 1974b).

The apparent complexity of the geology in the Wyse Corner area causes problems in determining its resource potential. Additional investigation is warranted to further establish lateral and vertical extent as well as the quality of the gypsum horizons already encountered. Should sufficient reserves be proven, shipping possibilities do exist via Sheet Harbour which is located approximately 70 km to the southeast.

CHAPTER 8. HANTS COUNTY



After Moore and Ferguson, 1986

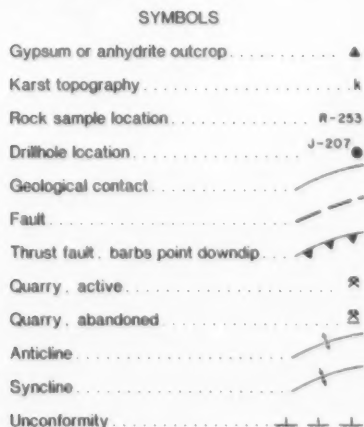
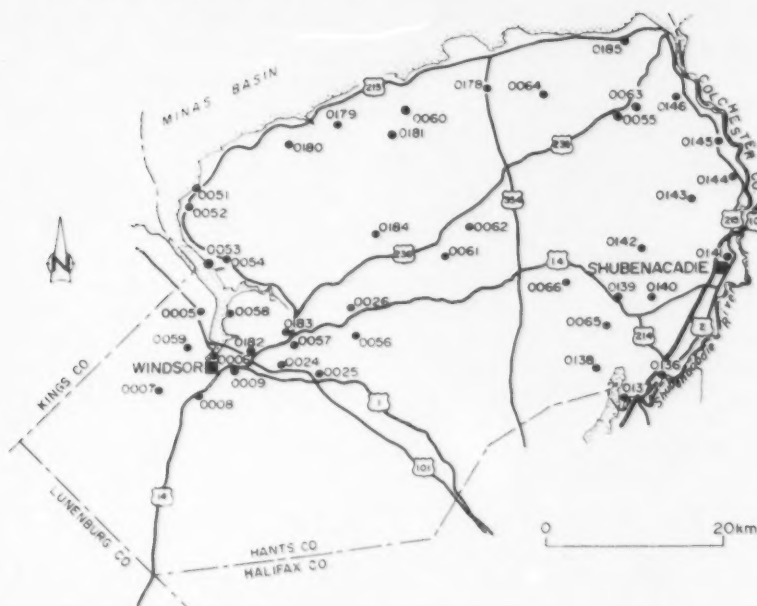


Figure 8-1. Geological legend for Windsor Basin, Hants County, gypsum and anhydrite occurrence maps.



After Giles and Boehner, 1982

Figure 8-2. Geological legend for Shubenacadie Basin, Hants County, gypsum and anhydrite occurrence maps.

**ADMIRAL ROCK (0144)**

NTS 11E/03C

UTM 468000 E 5003000 N

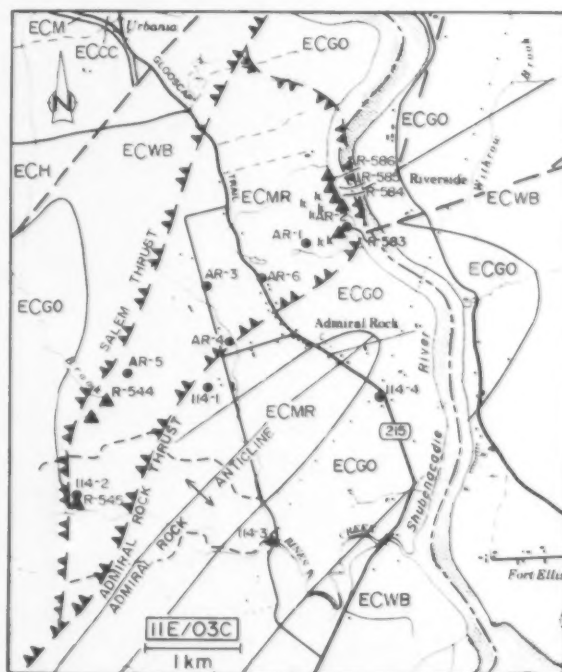
The Admiral Rock occurrence area is located 10 km north of the Village of Shubenacadie, Hants County (Fig. 8-4). Extensive karst topography and outcrops of gypsum can be found along the western side of the Shubenacadie River in this area. Other information is available from a number of diamond-drill holes completed by Great Horn Mining (International Mine Services Ltd., 1973) and St. Joseph Explorations Ltd. (McCulloch, 1974a) during the mid 1970s.

Much of this area is underlain by interbedded carbonates, sulphates and clastics of the MacDonald Road and Green Oaks Formations of the Windsor Group (Giles and Bochner, 1982). The most interesting area is a block of MacDonald Road Formation which overrides similar horizons from MacDonald Road and Green Oaks Formations to the south and east along the Admiral Rock Thrust and is in turn overlain to the west and northwest by the much younger Canso Group Watering Brook Formation along the Salem Thrust (Giles and Bochner, 1982).

Great Horn Mining drilled a series of six holes in this area in 1973 (AR-1 to AR-6) as part of a regional base metal exploration program (International Mine Services Ltd., 1973). Drilling was performed using a reverse circulation tricone rig and therefore all litholog-

ical descriptions were made using only chip or sludge samples. Abundant karst topography near some of these holes, as well as extensive gypsum outcropping along the Shubenacadie River nearby, help to support the drill log information. Three of these holes were completed between Route 215 and the River (AR-1, AR-2 and AR-6). Hole AR-1 went to a depth of 119.5 m passing through 30.5 m of overburden then 73.2 m of variable, impure gypsum with minor clay and limestone interbeds before encountering a thicker 6.1 m limestone and clay horizon. After drilling through this interbed, the hole continued on in gypsum until it was stopped. Hole AR-2 was stopped at 31.1 m after passing through a section similar to that seen in the top of AR-1. The horizons encountered in hole AR-6 approximately 600 m to the southwest are much the same.

Along the western bank of the Shubenacadie River in this area, there is a partially concealed exposure of



gypsum 450 m in length (only 95 m of which is concealed). The gypsum varies from fine grained, white to light grey with minor intermixed silt and carbonate to medium to dark grey selenitic with minor intermixed silt and carbonate. Although some minor subhorizontal laminae can be observed, they are also contorted and no attitudes are noted. Minor zones of what appear to be mudstone breccias having limestone and gypsum clasts can be observed in the middle portion of the section.

Drilling carried out by St. Joseph Explorations Ltd. in 1974 included one hole (114-2) near the southwestern end of the same thrust block as the AR series holes. In addition, three other holes (114-1, 114-3 and 114-4) were drilled around the Admiral Rock Anticline in the southern portion of the occurrence area (McCulloch, 1974a). Hole 114-2 appears to have been collared and completed in the MacDonald Road Formation and may be faulted in part. The other three holes all collared in the Green Oaks Formation and drilled through the MacDonald Road Formation into the underlying Stewiacke or Carrolls Corner Formations. Although all four holes encountered substantial sulphate horizons most of these were either deeply buried beneath overburden and other interbedded materials or were predominately anhydrite.

The Admiral Rock occurrence is considered to have good potential for development. Unfortunately, the AR series drillholes are unsuitable for detailed stratigraphic interpretation, therefore much additional work needs to be done in order to determine the geology and quality of the units in this area. Local karst topography, outcrop exposure and drillhole indications are favourable indicators and the potential exists for a deposit in excess of 10 Mt of gypsum in the area east of Route 215. The area is located approximately 60 km north of Halifax and 30 km east and south of Walton and may hold potential as a small sized producer.

AVONDALE (0058)

NTS 21H/01A

UTM 411000 E 4986400 N

The Avondale occurrence area is located 4.5 km north of Windsor, Hants County (Fig. 8-5). Two areas of gypsum outcrop can be found along the eastern bank of the Avon River and Moore and Ferguson (1986) indicated the presence of several abandoned gypsum quarries in this vicinity.

According to regional geological mapping by Moore and Ferguson (1986), the area is underlain by faulted blocks of Windsor Group rocks of the Miller Creek, Wentworth Station, Pesaquid Lake and Murphy Road

Formations as well as a small block of Canso Group, Watering Brook Formation.

One gypsum exposure can be found just south of Wallace Point where a 4 m thick bed of white to pink, fine grained to selenitic gypsum is interbedded between clastic redbeds. The unit grades from laminated at the apparent base to nodular mosaic at the apparent top. A possible karst solution feature can be seen in the form of a small lake inland along strike (130° Az from the outcrop).

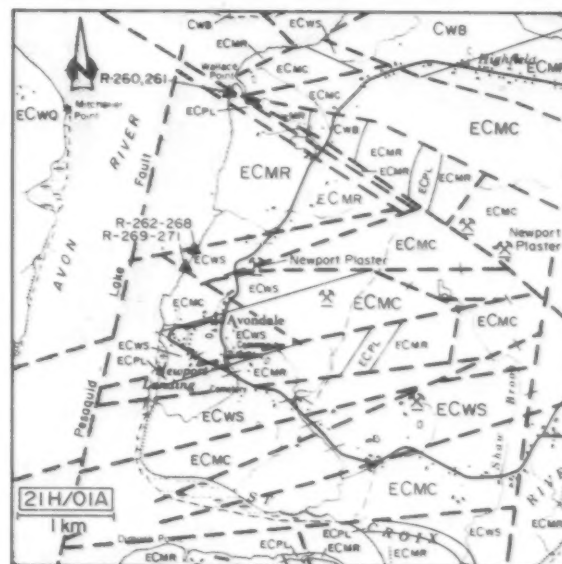


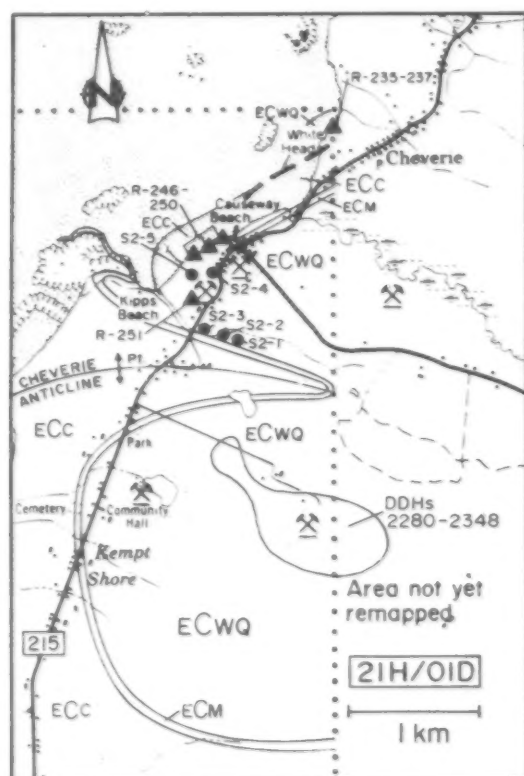
Figure 8-5. Location and geology of the Avondale occurrence area. See Figures 8-1 and 8-3 for legend and location.

A second exposure can be found 1700 m to the south of Wallace Point where a discontinuous sequence of moderate to steeply dipping, interbedded gypsum, siltstone and limestone extends over 280 m along the eastern bank of the River. Moore and Ferguson (1986) identified these units as belonging to the Wentworth Station Formation. Gypsum interbeds comprise approximately one-third of the section. The thickest sulphate exposure was a 20 m thick bed of fine grained, massive to nodular, white gypsum located at the northern end of the section.

Development potential of the Avondale area is considered to be poor even though a large part of the area is underlain by units of the sulphate-rich Miller Creek and Wentworth Station Formations because much of the immediate vicinity is used for agriculture. Gypsum rights over most of the area may be held by the Fundy Gypsum Company Ltd.

CHEVERIE (0051)
NTS 21H/01D
UTM 407400 E 5000800 N

The Cheverie occurrence area is located in and around the Village of Cheverie, Hants County, which is approximately 30 km north of the Town of Windsor (Fig. 8-6). Geological mapping by Ferguson (1983) determined that this area, which lies north of the Cheverie Point Anticline, is underlain by sulphates of the White Quarry Formation. These units are in conformable and fault contact with underlying carbonates of the Macumber Formation and clastics of the Cheverie Formation (Ferguson, 1983).



Geology modified after Ferguson, 1983

Figure 8-6. Location and geology of the Cheverie occurrence area. See Figures 8-1 and 8-3 for legend and location.

Gypsum and anhydrite can be found in outcrop along the shore at White Head and Causeway Beach as well as in the old quarries beside Route 215 within the Village. Hydration of the basal anhydrite appears, as elsewhere, to be from the surface downward and enhanced along the basal contact. Several drillholes in the area passed through this hydration zone into the underlying Macumber Formation (Quarch et al., 1979).

The thickest gypsum encountered was in Saarberg Interplan's hole S2-5 where 23.1 m of gypsum is underlain by 7.6 m of overburden (Quarch et al., 1979).

Although two past producing gypsum quarries are known in the area, production records are unclear and exact figures for production cannot be determined.

Two roads presently pass over the best gypsum sections in this area. Further away from the basal contact with the Macumber Formation, anhydrite becomes more common. Little opportunity exists for quarry development in the Cheverie area due to cultural development and the thin hydration (i.e. low potential volume of the basal anhydrite).

ELMSDALE (0136)
NTS 11D/13D
UTM 459500 E 4979000 N

The Elmsdale occurrence is located in and around the Village of Elmsdale, Hants County (Fig. 8-7). It lies southwest along strike from the Dutch Settlement area (0135), Halifax County, however the thick hydrated section seen at Dutch Settlement and East Milford (0134), Halifax County, is not present in this area.

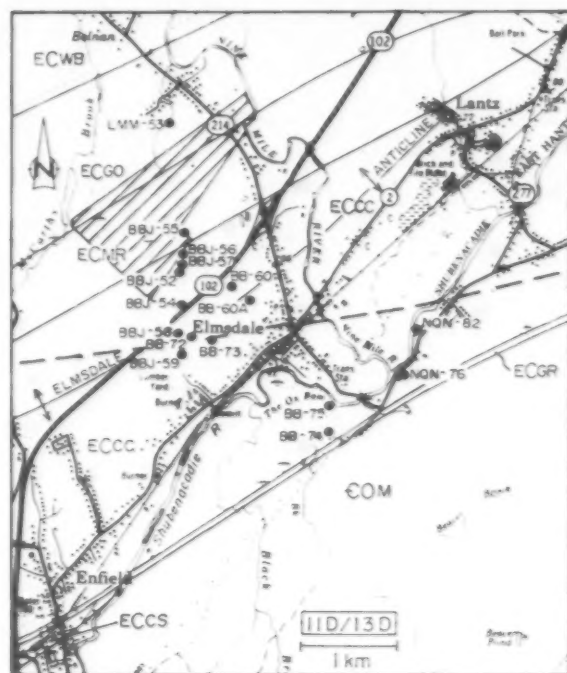
Regional geological mapping by Giles and Bochner (1982) indicated that the area is underlain by the sulphate dominated Carrolls Corner Formation along the southeastern margin of the Shubenacadie Basin. These units overlie the basal carbonate Gays River Formation and the Meguma Group metamorphic rocks to the southeast. A basement high is found in the area of Highway 102 and the Basin then deepens to the northwest where the Carrolls Corner Formation is overlain by interbedded sulphates, carbonates and clastics of the MacDonald Road Formation which is overlain by the Green Oaks Formation.

A total of 15 drillholes were put down in this area in 1974 by Amax Exploration Inc. as part of a regional base metal exploration program (Amax Exploration Inc., 1974g). All of these holes encountered varying thicknesses of gypsum and anhydrite. The thick hydrated section, seen at the base of the MacDonald Road Formation and top of the Carrolls Corner Formation at Dutch Settlement, is apparently not present in the Elmsdale area. This could be due to a lack of drilling immediately northwest of the Elmsdale Anticline where that portion of the section should occur.

The best gypsum intersected in the area is found along the Windsor-Meguma contact at the Basin margin. Both BB-74 and NQN-76 encountered thick white gypsum horizons (Amax Exploration Inc., 1974e). At

27.4 m, NQN-76's gypsum section was the thickest. It is overlain by 12.2 m of overburden. There appears to be the typical thick hydration of the basal anhydrite along the contact which is seen throughout the Province.

Development potential does not appear to be good in the Elmsdale area. Along the Basin margin some deeper hydration is observed, but does not appear to extend very far into the Basin. The Elmsdale area is also a rapidly developing community and this fact could preclude any mineral development.



Geology after Giles and Boehner, 1982

Legend: National Gypsum (lease)

Figure 8-7. Location and geology of the Elmsdale occurrence area. See Figures 8-2 and 8-3 for legend and location.

FALMOUTH (0059)

NTS 21H/01A

UTM 406300 E 4983700 N

The Falmouth occurrence area is located 3 km northwest of Windsor, Hants County (Fig. 8-8). It is geographically and geologically contiguous with the Mount Denson occurrence (0005) to the north and the Upper Falmouth occurrence (0007) to the south. Numerous areas of karst topography and some exposures of gypsum may be found within the area. Subsurface information was obtained from drillhole data provided by Interuranium Canada Ltd. (Saarberg Interplan Canada Ltd.) which is still held confidential under the uranium closure.



Geology after Ferguson, 1983, Moore and Ferguson, 1986

Figure 8-8. Location and geology of the Falmouth occurrence area. See Figures 8-1 and 8-3 for legend and location.

Geology mapping by Moore and Ferguson (1986) indicated that most of the area is underlain by the thick calcium sulphate unit of the Windsor Group White Quarry Formation which strikes north-northeastward through the area and dips to the east. This Formation is underlain to the west by the basal Windsor Group Macumber Formation carbonate and clastics of the Horton Group. Shey Lake appears to overlie a dissolution feature along the Windsor-Horton contact in this area. Most of the drillholes in this area encountered thick overburden (+30 m) along this contact as well. Hydration of the basal sulphate decreases basinward away from the contact. As in the Mount Denson area (0005), a number of faults appear to offset the contact.

Most of the Falmouth area is actively used for agriculture, and residential developments are gradually spreading. These factors would hinder possible quarry development and render the Falmouth occurrence of geological interest only.

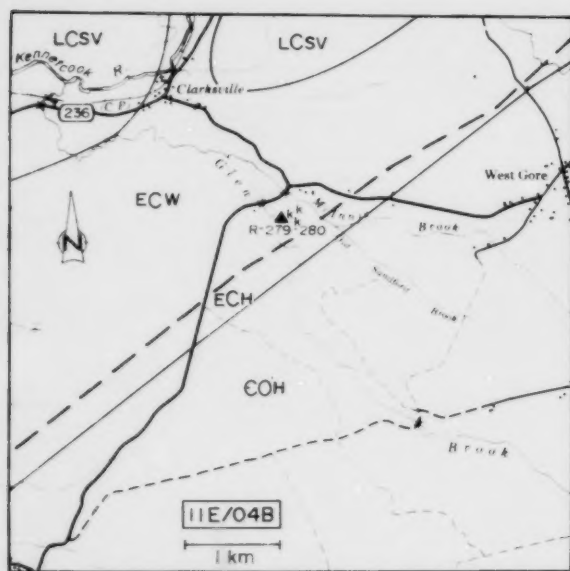
GLEN BROOK (0061)

NTS 11E/04B

UTM 435700 E 4992900 N

The Glen Brook occurrence is located 1.8 km southwest of Clarksville, Hants County, between Glen Brook on

the west and McNis Brook on the east (Fig. 8-9). Stevenson (1959) provided the most recent mapping in the area and included this area in his undivided Windsor Group. This section probably belongs to the White Quarry Formation.



Geology after Stevenson, 1959

Figure 8-9. Location and geology of the Glen Brook occurrence area. See Figures 8-1 and 8-3 for legend and location.

The occurrence consists of a large cliff, 20-30 m high, which extends for 100 m in a northeasterly direction. Moderate to heavy karst topography extends southeastward from the face towards the Windsor-Horton contact. Gypsum here is white, fine grained and massive, however hydration is shallow at the cliff with light blue, fine grained anhydrite visible at the top. This could be due to the rapid erosion of hydrated material adjacent to the Brook valley. Deeper hydration is evident in the heavily karsted area behind the cliff.

Little hydrated material (gypsum) remains in the immediate area between the Brooks at this occurrence. Development potential is limited by this factor as well as the distance to any possible shipping terminus.

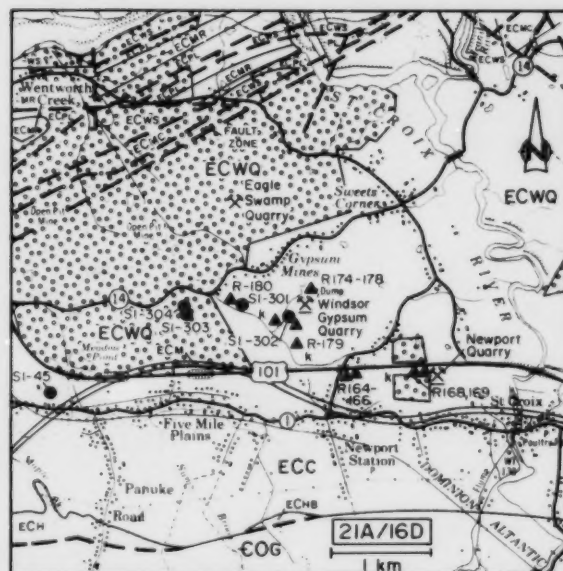
GYPSUM MINES (0024)

NTS 21A/16D

UTM 416700 E 4979700 N

The Gypsum Mines area is located 6 km southeast of the Town of Windsor, Hants County, just east of Three Mile Plains and west of St. Croix (Fig. 8-10). The sulphate dominated White Quarry Formation underlies

virtually all of the area and is underlain by Horton Group clastics to the south and overlain by the Miller Creek, Wentworth Station and Pesaquid Lake Formations to the north (Moore and Ferguson, 1986).



Geology after Moore and Ferguson, 1986

□ Fundy Gypsum (see simple)

Figure 8-10. Location and geology of the Gypsum Mines occurrence area. See Figures 8-1 and 8-3 for legend and location.

Within this area three quarries were operated in the early part of this Century (Jennison, 1911). The Newport Gypsum Quarry is located near Newport Station, the Windsor Gypsum Quarry lies south of the Village of Gypsum Mines and the Eagle Swamp Quarry is located on property still held by the Fundy Gypsum Company.

Numerous outcrops and sinkholes are found throughout the area. Hydration is generally restricted to the surface of the basal anhydrite with gypsum thicknesses <10 m. Although additional quarry potential in the Gypsum Mines area is poor, some of the material found in the Old Windsor Gypsum Quarry is very fine grained, dense gypsum which may be attractive to stone carvers.

HARDWOOD LANDS (0140)

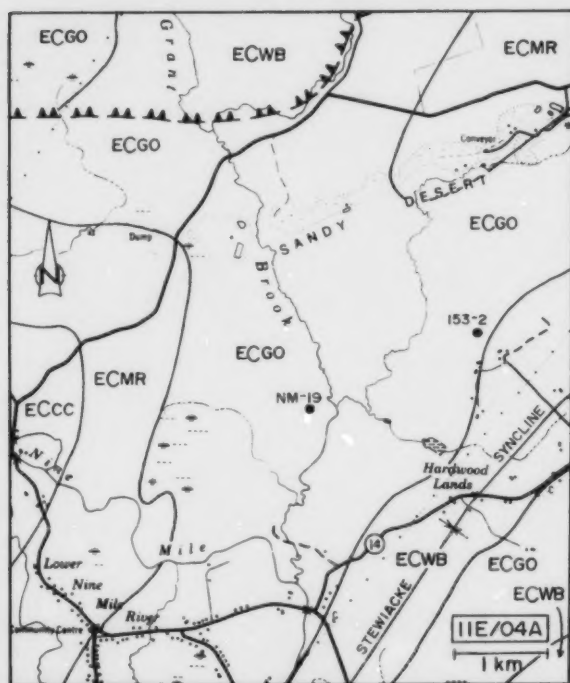
NTS 11E/04A

UTM 459000 E 4988000 N

The Hardwood Lands occurrence area is located 6 km west of the Village of Milford Station, Hants County (Fig. 8-11). It is a subsurface occurrence intersected by

two drillholes located nearly 2000 m apart and is of geological interest only.

This area is located near the northeasterly trending axis of the Shubenacadie Basin along the northwestern side of the Stewiacke Syncline (Giles and Bochner, 1982). Much of the area is underlain by interbedded carbonates, clastics and sulphates of the Green Oaks Formation which is overlain to the southeast by similar units of the Watering Brook Formation (Canso Group) and underlain to the northeast by the Cycle 2 (B Subzone) MacDonald Road Formation.



Geology after Giles and Boehner, 1982

Figure 8-11. Location and geology of the Hardwood Lands occurrence area. See Figures 8-2 and 8-3 for legend and location.

Imperial drilled one hole in the area in 1973 (NM-19) exploring for base metals (Johnston, 1973c), and St. Joseph Explorations Ltd. drilled a second hole (153-2) nearby in 1975 (St. Joseph Explorations Ltd., 1975). Both holes penetrated through the Green Oaks Formation into the MacDonald Road Formation and hole 153-2 bottomed in the salt/anhydrite sequence of the Cycle 1 (A Subzone) Stewiacke Formation.

Some gypsum was noted near the top of hole NM-19, however most of the thicker sulphate units seen in both holes are at depth and predominately anhydrite. These holes show units which can be correlated over

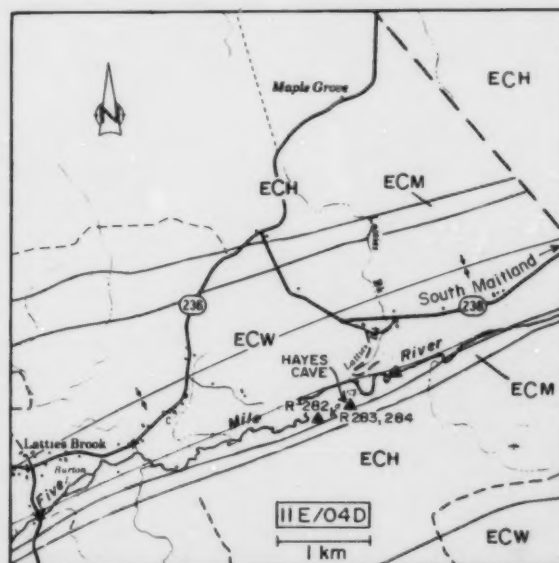
some distance and therefore may be traced updip to the northwest where they should subcrop. The base of the MacDonald Road Formation does not appear to be greatly disturbed in this area, as it is at East Milford (0134), Halifax County, where hydration occurs to +70 m depths. Nonetheless thick sulphate beds do occur in these sections which may be significant as they approach surface towards the margin of the Shubenacadie Basin.

HAYES CAVE (0063)

NTS 11E/04D

UTM 458600 E 5009900 N

The Hayes Cave occurrence is located 9 km south-southwest of Maitland, Hants County (Fig. 8-12). Mapped by Stevenson (1959) as undivided Windsor Group, the sulphates seen here are believed to belong to the A Subzone White Quarry Formation or Carrolls Corner Formation of the Windsor Group. They are underlain to the southeast by the basal Macumber Formation and clastics of the Horton Group (Stevenson, 1959).

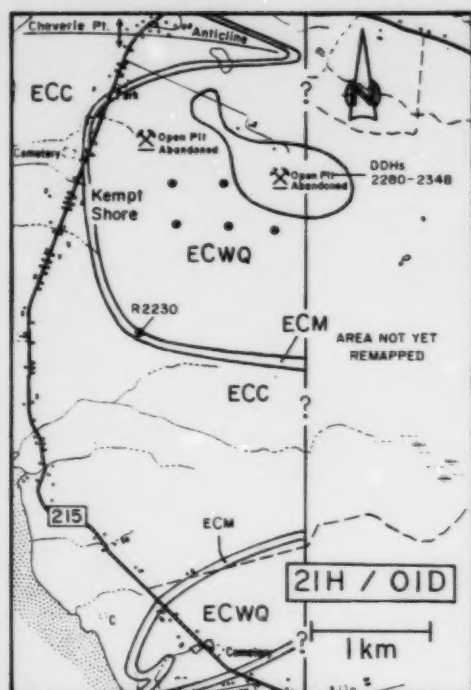


Geology modified after Weeks, 1946a; Stevenson, 1959

Figure 8-12. Location and geology of the Hayes Cave occurrence area. See Figures 8-1 and 8-3 for legend and location.

Three areas of anhydrite/gypsum cliffs and moderate to heavy karst topography extend for 2.2 km along the Five Mile River in this area. Cliffs often exceed 20 m in height and consist mainly of light blue, fine grained anhydrite which has been hydrated along its upper surface, along fractures and along minor petroliferous

Two abandoned gypsum quarries are located within this area. Production records are not clear from these pits so no production totals can be calculated. One block of ground in the area is still owned outright by National Gypsum (Canada) Limited.



Geology modified after Ferguson, 1983

Figure 8-14. Location and geology of the Kempt Shore occurrence area. See Figures 8-1 and 8-3 for legend and location.

During 1956 a government core drill was employed by B. A. Parsons Limited to complete a total of 69 holes over a portion of this area. Although the exact drillhole locations are not known, the rough drill logs show overburden thicknesses from 2.7-18.3 m and gypsum thickness between 1.8 and 39.0 m (Province of Nova Scotia, 1957a). Minor limestone and mudstone horizons are common within the gypsum sections and most of the holes bottomed in anhydrite.

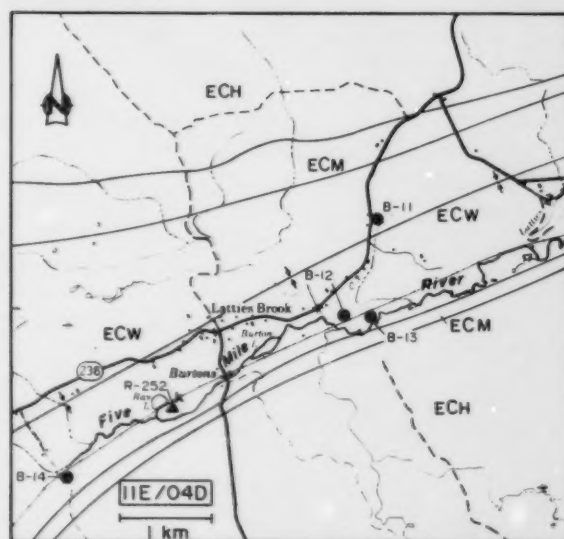
This area deserves additional evaluation to determine what reserves of gypsum or anhydrite might be available. It is possible that a small quarry could be operated in the area to supply the spot market.

LATTIES BROOK (0055)
NTS 11E/04D
UTM 454600 E 5008300 N

The Latties Brook occurrence area is located 11 km southwest of the Village of Maitland, Hants County (Fig. 8-15). Information available on this area consists of four diamond-drill holes completed by Imperial Oil Ltd. in 1974, numerous sinkholes and a single exposure of

gypsum found south of the Dominion Atlantic Railway right-of-way below Ray Lake (MacLeod, 1974).

This area straddles the boundary between Weeks' (1946a) Londonderry map and Stevenson's (1959) Kennetcook map area. Their mapping indicates that the area is underlain by units of the Lower Windsor Group in a narrow syncline which trends northeast-southwest along the valley of the Five Mile River. These include the basal carbonate Macumber Formation which is underlain by the Horton Group clastics. Local mapping by Imperial in the early 1970s indicated a more complex geological setting with a number of synclines and anticlines in the Windsor Group strata in the area (MacLeod, 1974).

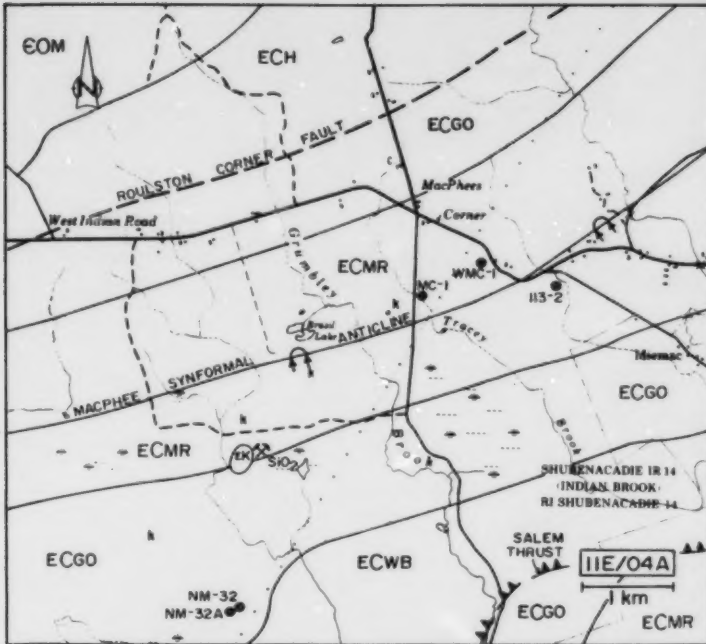


Geology modified after Weeks, 1946a; Stevenson, 1959

Figure 8-15. Location and geology of the Latties Brook occurrence area. See Figures 8-1 and 8-3 for legend and location.

The gypsum outcrop found at Latties Brook consists of a small (2 x 3 m) block of fine grained, dense, medium to light grey gypsum containing only minor intermixed carbonate material. It is found south of an area of moderate karst topography that extends 100-200 m north-south by 300-400 m east-west, parallel to the regional geological trend. Imperial's hole B-11 was collared near the middle of the syncline and encountered clastics before passing through +10 m of gypsum and anhydrite then into the basal carbonates (MacLeod, 1974). Three other holes were collared along the southern Windsor-Horton contact by Imperial Oil Ltd. Two were abandoned in thick overburden which probably represents a section of dissolved gypsum/anhydrite (B12,

Holes NM-32 and -32a passed through the Salem Thrust, into units at the base of the MacDonald Road Formation and through the Carrolls Corner Formation into the underlying Meguma Group metamorphic rocks. Within the overturned section, MC-1 was collared in the MacDonald Road Formation and stopped near the top of the Green Oaks Formation (Giles and Bochner, 1979). Hole 113-2 appears to have collared in the MacDonald Road Formation and stopped in the lower



Geology after Giles and Boehner, 1982

Figure 8-17. Location and geology of the MacPhees Corner occurrence area. See Figures 8-2 and 8-3 for legend and location.

through the middle of the area. Recent mapping by Moore and Ferguson (1986) indicated that a fault-bound block of Wentworth Station Formation underlies much of the immediate area. These rocks are in contact with the overlying Pesaquid Lake and Murphy Road Formations to the east, White Quarry, Miller Creek and Wentworth Station Formations to the south and west, as well as Murphy Road and Wentworth Station Formations to the north.

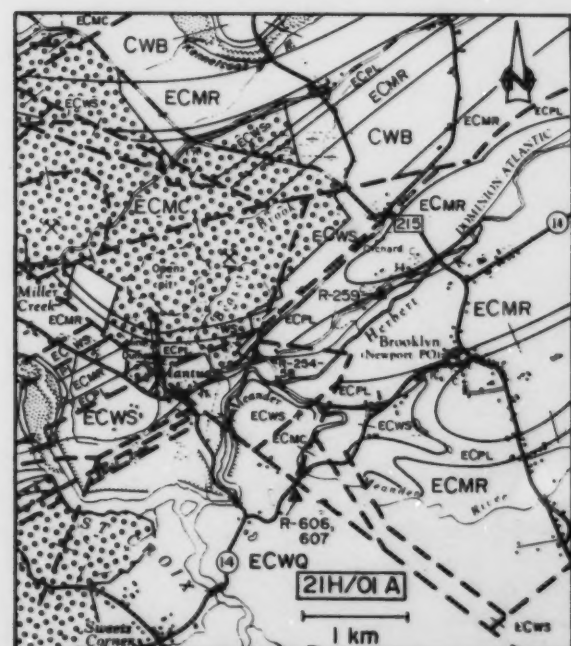
Samples taken during this survey, from gypsum outcrops in the area, produced high purity gypsum assays (Appendix 3). However much of the gypsum has probably been removed by the action of the Herbert River. Little possibility exists for the development of the remaining gypsum in the Mantua area because Route 14 passes through the northern portion of the area where potential resources of gypsum could still exist. In addition, the interbedded nature of the Wentworth Station Formation is not conducive to economic extraction of the gypsum units found in it. As a result the

part of the Green Oaks Formation. Several areas of surface karst can be identified in this area. L. E. Shaw's West Indian Road Cretaceous silica sand deposit reportedly occupies a large solution feature (Fowler, personal communication).

Those areas which are underlain by either the upper portion of the Carrolls Corner Formation or the base of the MacDonald Road Formation hold good potential for being deeply hydrated. Hole 113-2, for example, intersected 70.1 m of variably impure gypsum, but is overlain by 88.4 m of overburden and apparent solution fill material. This highly disturbed area may also be deeply hydrated elsewhere along strike. In general, the MacPhees Corner area holds good potential for large gypsum deposits, however much additional work needs to be done beginning with the area around hole 113-2.

MANTUA (0057)
NTS 21H/01A
UTM 418400 E 4983700 N

The Mantua area is located just west of the Village of Brooklyn, Hants County, and southeast of Fundy Gypsum's Miller Creek Quarry (Fig. 8-18). Numerous outcroppings of Windsor Group strata can be found along the abandoned Dominion Atlantic Railway right-of-way as well as along the Herbert River which runs



Geology after Moore and Ferguson, 1986

 Fundy Gypsum (fee simple)

Figure 8-18. Location and geology of the Mantua occurrence area. See Figures 8-1 and 8-3 for legend and location.

Mantua occurrence is primarily of geological interest at this time.

MARTOCK (0008)
NTS 21A/16D
UTM 407050 E 4976150 N

The Martock occurrence area is located 4 km southwest of the Town of Windsor, Hants County (Fig. 8-19). This occurrence area extends from Windsor Forks in the southwest to Three Mile Plains in the east. Rocks of the White Quarry Formation dominate the area and are overlain by interbedded sulphates, siltstones and carbonates of the Miller Creek, Wentworth Station and Pesquid Lake Formations to the north and west. They are underlain by clastic sedimentary rocks of the Horton Group and in one small area by Devonian-Carboniferous granodiorite to the south and east.

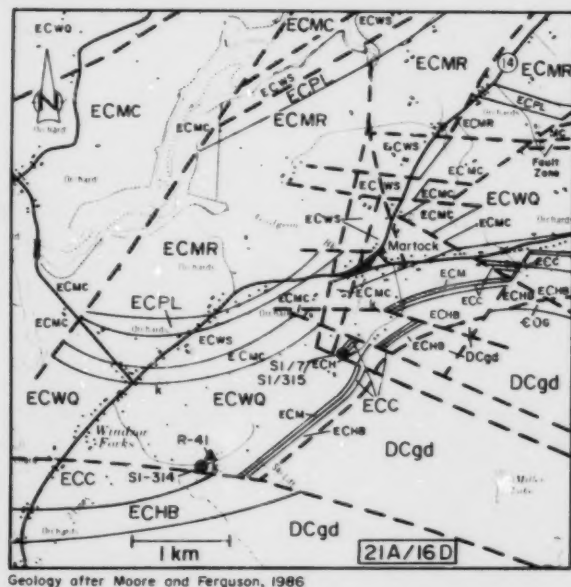


Figure 8-19. Location and geology of the Martock occurrence area. See Figures 8-1 and 8-3 for legend and location.

Only minor outcroppings of gypsum and anhydrite and limited karst can be seen in this area. Limited drillhole information in this area does not contribute much information on hydration of the anhydrite here. Extensive faulting interpreted by Moore and Ferguson (1986) would suggest the potential for extensive gypsum, however the presence of a small stream valley along the White Quarry/Cheverie contact in the area may have removed much of the gypsiferous section. This stream as well as cultural conditions would prohibit any mining development in the Martock area, subsequently it is of geological interest only.

MCKAY SECTION (0056)
NTS 11E/04B
UTM 424800 E 4984700 N

High purity, white gypsum has been produced from quarries in the McKay Section (McKay Settlement, historical name) area 15 km east of the Town of Windsor, Hants County, for over 45 years (Fig. 8-20). The Windsor Plaster Company opened a calcining plant in Windsor in 1891 and that plant has remained in operation ever since. Gypsum, Lime and Alabastine Ltd. took over the company in 1956 and were in turn bought out by Domtar Construction Materials Ltd. in 1962 (King, 1985).

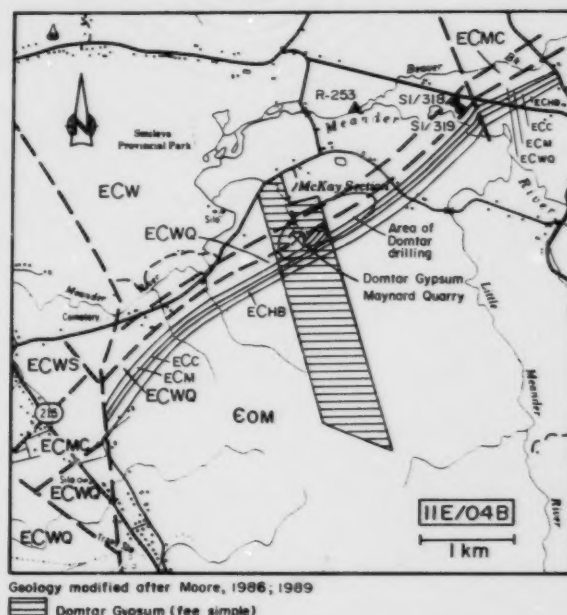


Figure 8-20. Location and geology of the McKay Section occurrence area. See Figures 8-1 and 8-3 for legend and location.

Prior to 1943 gypsum for the Windsor plant was taken from quarries other than those at McKay Section. In 1943 the Veinot Quarry, located 400 m northeast of the present site, was opened. Shortly afterwards the Maynard Quarry, which is still in production today, was developed and began to produce in 1946. Some evidence exists to indicate that small scale production may have occurred at the Baxter Quarry located 500 m southwest of the Maynard.

Accurate production figures are not available for the years 1942-1947, however between 1948 and the present a total of 400 305 t of gypsum have been extracted from this area (Nova Scotia Department of Mines and Energy,

Annual Reports, 1949-1988). This represents a minor quantity to this Province's total production, but it is the only product which is processed in Nova Scotia.

Recent geological mapping in the area by Moore (1986; 1989) indicated that a narrow, northeasterly trending band of calcium-sulphate dominated White Quarry Formation underlies the quarried area at McKay Section. This unit is underlain to the southeast in descending order by the basal Windsor Group carbonate (Macumber Formation), clastics of the Horton Group and finally by metamorphics of the Meguma Group. According to Moore (1986), interbedded carbonates, clastics and calcium sulphates of the Miller Creek Formation are in fault contact with the White Quarry units to the northwest. A solution trench which has been infilled by sand and clay materials has been identified and partially defined by diamond drilling carried out by Nova Scotia Department of Mines drills for Gypsum, Lime and Alabastine Ltd. in 1956 (Province of Nova Scotia, 1957b). This feature is typical of solution trenches which can be seen at a number of locations elsewhere in the Province, such as Ottawa Brook (0083), Victoria County.

The only diamond-drill hole information in the McKay Section area available from assessment reports is of two holes put down 2 km northeast of the Maynard Quarry by Saarberg Interplan Canada Ltd. in 1981. Doyle (1982) determined that these holes penetrated an overturned section of the White Quarry Formation. A small gypsum outcrop area can be found along the northern side of the Meander River at a location 500 m upstream from Smileys Provincial Park. Several rounded heads 2-3 m wide by 2-3 m high consist of light grey, fine grained, massive to slightly nodular gypsum. Moore's (1986) mapping at this locale shows the Upper Windsor Murphy Road Formation and Watering Brook Formation of the Canso Group. (For detailed mapping see Moore, 1986.)

As is the case in other actively quarried areas, very little information is publicly available on the geology of the McKay Section property. Although exact locations and collar elevations are not given in reports of government drilling, holes put down in the Maynard Quarry area in 1956 and 1965 often passed through >30 m of white gypsum overlain by shallow overburden of <5 m. One hole (NSDM 2208) drilled in 1956 drilled through 52.7 m of white gypsum before being stopped still in gypsum (Province of Nova Scotia, 1957b).

In recent years, Domtar Gypsum has again undertaken drilling programs in the area, along strike and

down dip from the Maynard Quarry. Although results are not known, it is speculated that sufficient reserves are present in the McKay Section area to supply Domtar's small plant in Windsor for many years to come. Should additional development be considered in the future, this area is located approximately 60 km from possible shipping sites in the Halifax Harbour area or 30 km from the tidal port of Hantsport.

MILLER CREEK (0183)

NTS 21H/01A

UTM 417000 E 4985000 N

Gypsum has been produced from the present Miller Creek site, 6 km northeast of the Town of Windsor, Hants County (Fig. 8-21), by the Fundy Gypsum Company Ltd. (and its predecessor, the Canadian Gypsum Co.) since 1957 (King, 1985). Jennison (1911) referred to abandoned quarries at Miller Creek, and Mosher (1979) mentioned a quarry in the same area being opened up in 1908-1909.

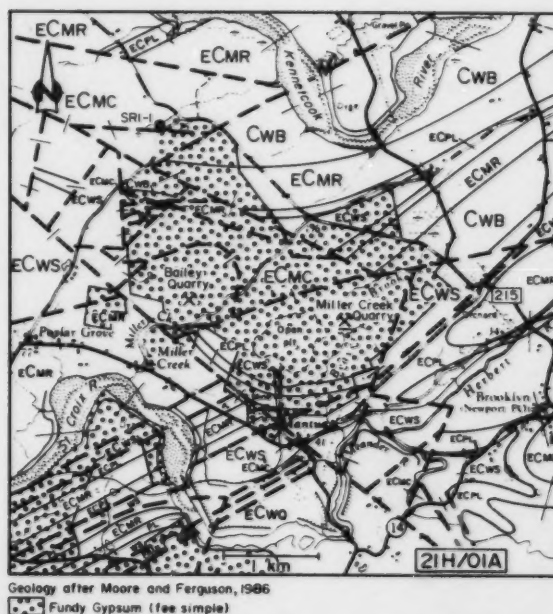


Figure 8-21. Location and geology of the Miller Creek occurrence area. See Figures 8-1 and 8-3 for legend and location.

The Canadian Gypsum Co. began site preparation at the current location in 1956 and production began the following year (Province of Nova Scotia, 1959). In 1962, the Canadian Gypsum Co. became the Fundy Gypsum Company Ltd. (King, 1985). Gypsum production figures reported by the Company to the Nova Scotia

Department of Mines and Energy are combined tonnages from both the Miller Creek and Wentworth Creek sites (0182). Production from the original Miller Creek Quarry continued until about 1978 when minable reserves were exhausted. At that time a second quarry, the Bailey Quarry, adjacent to the first was opened. The Bailey continues to produce while the old Miller Creek Quarry is now used to dispose of impurities screened off in the crushing process. A conservative estimate of Miller Creek's production to date would be about 25 Mt. All of the gypsum produced here is taken by train 21 km west to the Company's loadout facilities at Hantsport. Company vessels as well as chartered ships then carry the gypsum to wallboard plants along the Eastern Seaboard of the United States from Boston, Massachusetts, to Houston, Texas.

Recent detailed geological mapping by Moore and Ferguson (1986) indicated that much of the Miller Creek area is underlain by highly complex, structurally deformed units of the Miller Creek Formation. Lewis and Holleman (1983) stated the following, "Frequently one or more stratigraphic members will be intersected three or four times in a vertical, 100 m drillhole. . . ." Interbedded calcium sulphates, carbonates and clastics of the Miller Creek Formation present a complex and consequently somewhat more expensive mining situation where stripping and grade control must be carefully monitored. These units are in fault contact with interbedded carbonates, clastics and calcium sulphates of the Wentworth Station, Pesaquid Lake and Murphy Road Formations which surround the Quarry area. To the northwest, 2 km away, similar fault-bound blocks of the Miller Creek Formation were the location of smaller quarries in the late 1800s and early 1900s (Moore and Ferguson, 1986).

As with the Wentworth Creek Quarry area (0182), little detailed drillhole information is publicly available on the Miller Creek area. The only exploration drilling undertaken in this vicinity was a single hole (SR1-1) put down by Scurry-Rainbow Oil Ltd. in 1966 as part of its regional sulphur exploration program (Kawase, 1967). Unfortunately the rotary drill did not core the section and only produced chip samples to determine the lithology. Considering the geological complexity of this area, the lithological log of SR1-1 is of little use in stratigraphic interpretation.

Hydration depths of the calcium sulphate horizons at Miller Creek are typical of those occurring in the Cycle 2 (B Subzone) elsewhere in the Province. As a result of enhanced permeability of these sections due to

the presence of porous interbeds and deformation related to folding, fracturing and fault zones, hydration often extends to depths in excess of 50 m below surface. The gypsum at Miller Creek is of lower purity than that at Wentworth, having up to 25% interstitial carbonate and clastic material in the calcium sulphate beds in addition to the carbonate and clastic interbeds themselves. Selective mining and beneficiation by screening after crushing results in a product suitable for the manufacture of gypsum wallboard.

Reserve calculations for Miller Creek are not available and without drillhole and analytical information it is impossible to attempt such a calculation. Fundy Gypsum probably has sufficient gypsum at Miller Creek to sustain its operations for the short term future. Other areas in the vicinity to the northeast, underlain by similar units of the Miller Creek Formation are not owned by the company nor are the gypsum rights held (King, 1985). Recent exploration by Fundy Gypsum at Dutch Settlement (0135), Halifax County, suggests that it is considering establishing a site there with additional reserves of gypsum. At the time of writing a decision regarding the Dutch Settlement property is on hold as a result of corporate financial problems.

MOUNT DENSON (0005)

NTS 21H/01A

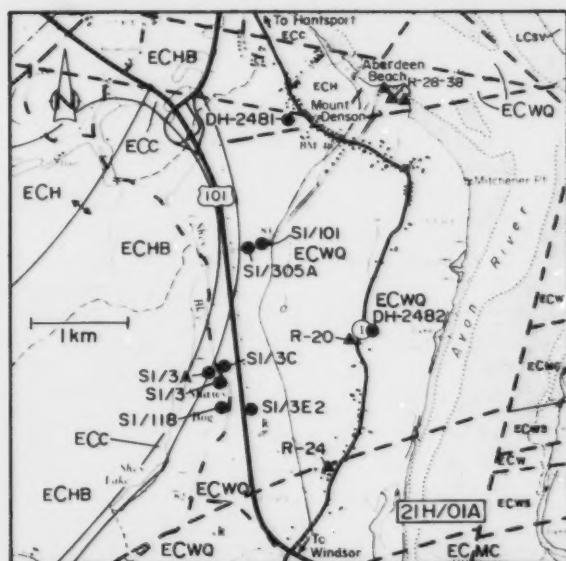
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Located between Windsor and Hantsport in Hants County, this occurrence area has to be divided arbitrarily due to the fact that the entire Hantsport-Windsor area is underlain by Windsor Group rocks and numerous drillholes have been completed here (Fig. 8-22). This occurrence discussion will include an area bounded on the north by an east-west fault which cuts through Mount Denson (Ferguson, 1983; Moore and Ferguson, 1986) south to the top of Shey Lake (Falmouth, 0059).

The area is generally underlain by the sulphates and minor carbonates of the White Quarry Formation of the Windsor Group which in turn are underlain by interbedded clastics of the Cheverie and Horton Bluff Formations of the Horton Group to the west. A series of faults appears to offset this sequence at regular intervals through the area. The White Quarry Formation attains thickness in excess of 200 m in the area (DH-2482) and is dominated by anhydrite (Province of Nova Scotia, 1958). Hydration appears to be surficial for the most part with some gypsum thickening in the vicinity of faults and along the White Quarry-Cheverie

contact where it has not been eroded away. Karst is generally poorly developed in this area. This is due to the fact that overburden ranges from 10-50 m in thickness.

A section of the White Quarry Formation can be observed in the northern part of the Mount Denson area, at Aberdeen Beach 2 km southeast of the Town of Hantsport, Hants County. Large exposures of high purity, light blue anhydrite overlain by white, fine grained gypsum up to 10 m in height extend 400 m along the western bank of the Avon River at this locale.



Geology modified after Ferguson, 1983; Moore and Ferguson, 1986

Figure 8-22. Location and geology of the Mount Denson occurrence area. See Figures 8-1 and 8-3 for legend and location.

Although of economic interest due to the potential volumes of gypsum and anhydrite available, this area is traversed by Highway 101, the Dominion Atlantic Railway, Route 1 and a secondary roadway all of which would inhibit development.

NINE MILE RIVER (0139)

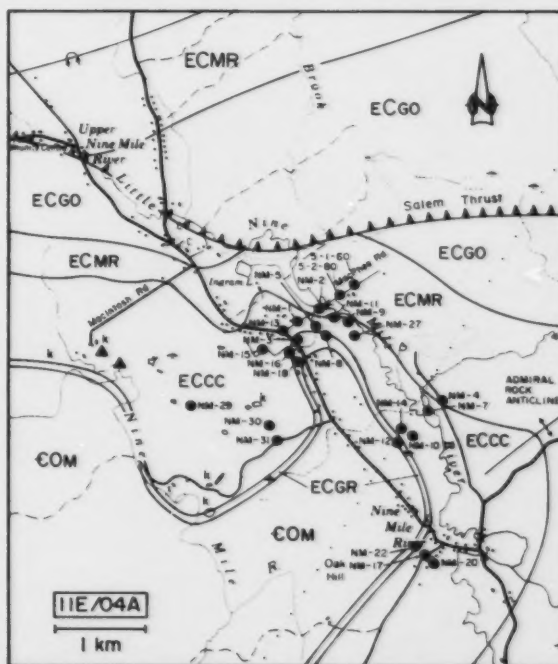
NTS 11E/04A

UTM 453000 E 4989500 N

The Nine Mile River occurrence area is located 12 km northwest of the Village of Elmsdale, Hants County (Fig. 8-23). It includes several areas of karst topography, minor gypsum outcrops as well as 19 drillholes which encountered gypsum and anhydrite. Drilling was carried out in 1973 as part of a base metal exploration joint venture between Jorex and Imperial Oil Ltd.

(Johnston, 1973c) and again in 1980 when L. E. Shaw drilled two shallow holes in search of sand deposits (Smith, 1981).

Geological mapping by Giles and Boehner (1982) indicated that much of this area is underlain by the Carrolls Corner Formation along the western margin of the Shubenacadie Basin. A Meguma Group high extends out into the Basin in this area (Admiral Rock Anticline) and an associated carbonate buildup Gays River Formation along this feature was the focus of the Jorex/Imperial drilling. Little outcrop information is available away from the Basin margin, however Giles and Boehner (1982) indicated a typical section of interbedded carbonates, sulphates and clastics of the MacDonald Road and Green Oaks Formations overlying the Carrolls Corner Formation to the north and east. Slightly to the north of this area they indicated that units of the Green Oaks Formation have overridden part of the area along the Salem Thrust Fault.



Geology after Giles and Boehner, 1982

Figure 8-23. Location and geology of the Nine Mile River occurrence area. See Figures 8-2 and 8-3 for legend and location.

Several areas of light to moderate karst topography, having small isolated sinkholes, occur in the Nine Mile River area. Well developed karst is found at the western end of MacIntosh Road where several fine grained, white gypsum heads are exposed. Drillhole information indicates that hydration along the Carrolls Corner-Gays

River Formations contact is typical with gypsum thicknesses up to 23 m overlain by similar thicknesses of overburden. Further away from the basin margin hole NM-4 may have collared near the base of Cycle 2 (B Subzone) MacDonald Road Formation (Giles and Boehner, 1979). It, along with several other holes along strike to the north-northwest, encountered thick overburden in the valley of the Nine Mile River before encountering gypsum bedrock. Two holes drilled east of the River in the immediate vicinity were completed by L. E. Shaw along MacPhee Road (Smith, 1981). Both passed through shallow overburden 10.7 m and 4.6 m, before entering gypsum. Hole 5-1-80 drilled through 6.1 m of gypsum before being stopped and hole 5-2-80 drilled 13.7 m of gypsum before stopping in gypsum.

The Nine Mile River occurrence area shows typical hydration at the base of the Windsor with potential for small high purity gypsum deposits along the contact. It also has good indications for the East Milford (0134), Halifax County, intermixed to interbedded type of deposit at the contact between the Carrolls Corner and MacDonald Road Formations. Attractive areas occur east of Nine Mile River in the MacPhee Road area. This particular area has been developed for its granular aggregate and industrial sand resources which might facilitate gypsum development in the area. Further drilling is warranted in this highly prospective area which is approximately 48 km from shipping at Halifax.

NOEL LAKE (0178)
 NTS 11E/05A
 UTM 443550 E 5012700 N

The Noel Lake occurrence is located 10 km north of the Village of Kennetcook, Hants County (Fig. 8-24). This area was the site of gypsum production carried out by the Noel Plaster Co. between 1906 and 1914. Several areas of karst topography, an area of gypsum outcrop as well as extensive overburden drilling in the area help to delineate those areas underlain by gypsum and anhydrite.

Nova Scotia Department of Mines, Annual Reports from the early 1900s indicated that the Noel Plaster Co. produced gypsum for export between 1906 and 1914. Jennison (1911) reported that two quarries were worked, one west of Noel Lake and a second east of the Lake. Little evidence of either site can be seen on the ground at present, although the exposures found to the east of the Lake are probably related to one of these sites. According to King (1985), all the gypsum produced at Noel was sold to J. B. King and Co. of New York with shipments made via barge out of a pier at Noel.



Figure 8-24. Location and geology of the Noel Lake occurrence area. See Figures 8-1 and 8-3 for legend and location.

Detailed geological mapping in this area was carried out by Shell Canada Resources Ltd. and Billiton Canada Ltd. including an extensive overburden drilling program (Cornish, 1980; Hart and Cornish, 1981; and MacGillivray, 1983). This modified the previous regional mapping of Weeks (1946b) and Stevenson (1959). Much of the Noel Lake area is underlain by a narrow, easterly trending band of Lower Windsor Group strata which dips southward. These units are offset by northerly faults and are underlain to the north by clastics of the Horton Group. They are overlain by interbedded clastics, carbonates and sulphates of the Upper Windsor Group to the south (Cornish, 1980).

The only exposures found in the Noel Lake area occur east of Noel Lake, 500 m southwest of Louis Crowe Lake where a number of heads can be found in an area of moderate to heavy karst (250 x 100 m elongate 110°). The gypsum is fine- to medium-grained, light grey and massive. Shell's (1980) holes were able to determine the nature of bedrock, however they did not extend >1-2 m into bedrock and therefore are of little use for stratigraphy on more than a gross scale (Hart and Cornish, 1981). In 1983, Billiton Canada Ltd. drilled a series of eight diamond-drill holes in the same area which substantiated the geological contacts determined by Shell (MacGillivray, 1983). Although the descriptions of the gypsum and anhydrite intervals are

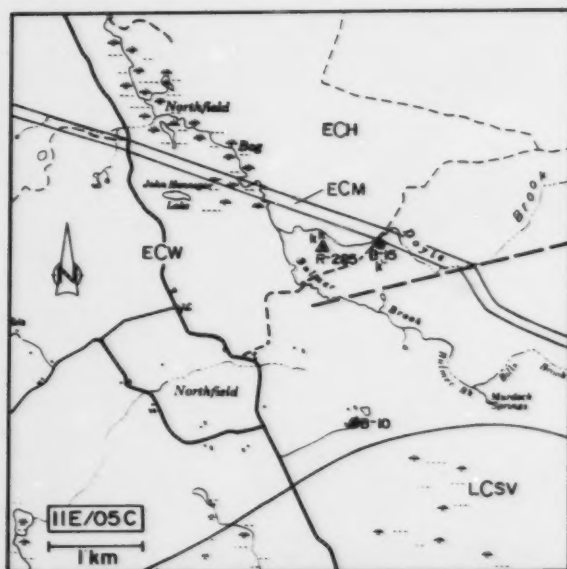
unclear, the thicker gypsum sections were intersected west of Noel Lake in holes 8, 10 and 11. Hole 8, inclined 74°, intersected 65.51 m of gypsum with minor interbeds and lenses of silty limestone overlain by 15.86 m of overburden. True thickness is estimated to be 64.9 m.

Typical of the geology along the northern flank of the Windsor Basin, the Noel Lake occurrence consists of a narrow band of gypsum/anhydrite horizons which dip steeply into the Basin. Consequently, the gypsiferous area here is of limited extent and has limited development potential. The nearest possible point of shipment would be at Walton 30 km to the west where barite from the Walton Mine was once shipped out on vessels up to 6400 t.

NORTHFIELD (0064)
NTS 11E/05A
UTM 448500 E 5011700 N

The Northfield occurrence is located 9.5 km north-northeast of the Village of Kennetcook, Hants County (Fig. 8-25). A number of small, rounded outcrops, two drillholes and several small areas of karst topography comprise all of the information available on this occurrence.

Local geology mapping by Shell Canada Resources Ltd. (Cornish, 1980) modified regional mapping by



Geology modified after Cornish, 1980; MacLeod, 1974

Figure 8-25. Location and geology of the Northfield occurrence area. See Figures 8-1 and 8-3 for legend and location.

Weeks (1946a) and Stevenson (1959). Much of the vicinity is underlain by units of the Lower Windsor Group which strike northwest-southeast through the area and dip to the southwest. These are underlain to the north and northeast by Horton Group clastics and overlain to the south by clastics of the Scotch Village Formation of the Pictou Group.

Several small (1.5 x 2 m) outcrops of fine grained, white gypsum can be found in an area of moderate karst topography located just south of Doyle Brook (Etter Brook, local name). Other areas of karst can also be seen along strike both to the southeast and northwest. Two diamond-drill holes were completed in the Northfield area by Imperial Oil Ltd. in 1974 as part of a regional base metals exploration program (MacLeod, 1974). Hole B-15, collared near the Windsor-Horton contact appears to have encountered an infilled dissolution zone above the basal Windsor carbonate. Located 1900 m into the Carboniferous basin to the south, hole B-10 encountered a section of gypsum, carbonates and thick clastics which ended in a salt bearing anhydrite unit. Stratigraphic interpretation of this hole has not yet been attempted, however this hole probably intersected a disturbed section of the bottom of the Upper Windsor Group.

Although of high purity, the gypsum seen at Northfield appears to be of very limited extent. Little economic potential exists for large scale development of this area, however a rapidly growing agricultural industry in the area could use limited volumes of material locally.

NORTH SALEM (0143)
NTS 11E/03C
UTM 464250 E 4999300 N

The North Salem occurrence area is located 8.5 km northwest of the Village of Shubenacadie, Hants County (Fig. 8-26). Small areas of karst topography can be found just northwest of the Atlantic Motorsport Park, however outcrops of gypsum or anhydrite were not located in the area. Geological information on this area comes from seven base metal exploration holes drilled by three companies between 1973 and 1975.

This area is located near the northern end of the overturned MacPhee Synformal Anticline (Giles, 1977). Giles (1977) correlated drillhole information from Denison Mines Ltd.'s five holes (WJ series) drilled in 1975 (Chan, 1975) to help determine the overturned nature of the interbedded carbonates, sulphates and clastics of the MacDonald Road and Green Oaks

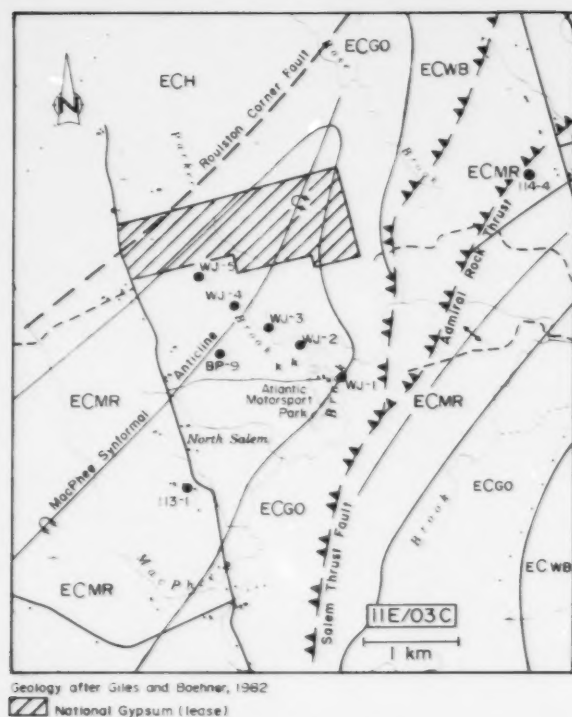


Figure 8-26. Location and geology of the North Salem occurrence area. See Figures 8-2 and 8-3 for legend and location.

Formations in this structurally disturbed area. Much of the immediate area is an overturned section consisting of the MacDonald Road Formation which is underlain by the Upper Windsor Group Green Oaks Formation which is underlain by the Watering Brook Formation of the Canso Group. Similar to the MacPhees Corner area, this entire block overrides similar units to the south and east along the Salem Thrust Fault and is also in fault contact to the northwest with older Horton Group clastics across the Roulston Corner Fault.

Imperial Oil Ltd. drilled hole BP-9 in 1973 as part of a regional exploration program (Bochner, personal communication). This hole encountered an overturned section of sulphate, carbonate and clastic horizons which probably represents the base of the MacDonald Road Formation and possibly the top of the Carrolls Corner Formation. The hole stopped at 239.9 m still in the MacDonald Road Formation. Although covered by 51.8 m of overburden and other sedimentary rocks, 56.5 m of variably impure gypsum were intersected (51.82-103.33 m). Although this may be structurally thickened, the gypsum horizon would be of economic interest up dip should it come near surface.

Hole 113-1 was drilled by St. Joseph Explorations Ltd. in 1974 as part of a regional base metal exploration program (McCulloch, 1974a). It intersected an overturned sequence and collared near the base of the MacDonald Road Formation and stopped in the upper part of the Green Oaks Formation. After passing through 17.8 m of overburden, it intersected 15.4 m of impure gypsum containing variable amounts of calcareous material.

Although only a few drillholes have been put down in the North Salem area, interesting intersections of deeply hydrated MacDonald Road Formation have been encountered. Further drilling in the vicinity of BP-9 and 113-1 could readily determine if these hydrated sections are laterally extensive. Large areas of as yet undeveloped land are located along strike to the north-northeast of these holes which might allow for mineral development. The area is approximately 60 km from possible shipping sites in the Halifax Harbour area. These factors make the North Salem area a candidate for further investigation.

PEMBROKE (0180)

NTS 21H/01D

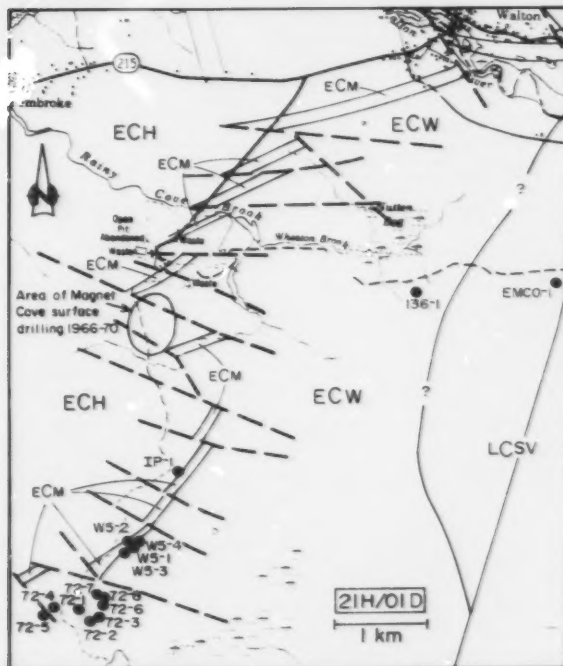
UTM 418500 E 5006000 N

The Pembroke occurrence area is located 3 km southwest of the Village of Walton, Hants County (Fig. 8-27). The Horton-Windsor contact extends both to the northeast and south of the abandoned Walton Barite Mine which lies in the midst of this occurrence area. Virtually all available data were obtained from exploration drillholes completed by numerous companies in the area.

Although no gypsum or anhydrite has been mined along this margin of the Windsor Basin, the area is best known as the location of the Walton barite-lead-zinc-copper-silver deposit as well as several manganese mines. Numerous episodes of mineral exploration drilling have been carried out in search of similar deposits in this area. Regional geological mapping by Boyle (1972) indicated a complex geological setting with highly faulted, steeply dipping to overturned structure along the Horton-Windsor contact through this entire section of the Basin. This fact is reflected in the subsurface information from the Walton Mine (Boyle, 1972) as well as from the available drill logs. In general, much of this area is underlain by undivided Windsor Group strata of interbedded clastics, carbonates, calcium sulphate and salt. These are overlain to the east and southeast by clastics of the Pictou Group Scotch Village Formation

and are underlain to the northwest and west by clastics of the Horton Group. At the base of the Windsor, the Macumber Formation has been recognized and mapped, however deep dissolution (+300 m) of the basal calcium sulphates along this contact with infilling by clastic materials makes it even more difficult to map the disrupted geology of the Lower Windsor Group.

Although thick sections of gypsum and anhydrite have been noted in drillholes in this area, virtually all are overlain by +30 m of clastic infill material. This would prevent any possible gypsum and anhydrite development in this area, therefore the calcium sulphates in the Pembroke area are of geological interest only.



Geology modified after Boyle, 1972

Figure 8-27. Location and geology of the Pembroke occurrence area. See Figures 8-1 and 8-3 for legend and location.

RIVERSIDE CORNER (0062)

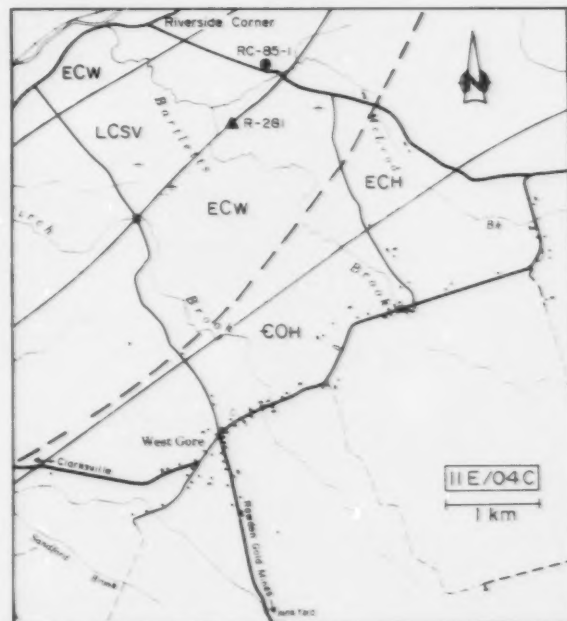
NTS 11E/04C

UTM 438800 E 4996700 N

The Riverside Corner occurrence is located 4.5 km southeast of Clarkesville, Hants County (Fig. 8-28). Mapping by Stevenson (1959) showed the area underlain by undivided Windsor Group and overlain to the northwest by clastics of the Scotch Village Formation (Canso

Group) and underlain to the southeast by clastics of the Horton Group.

Although some fine grained, white gypsum debris can be seen along a woods road on the eastern side of Bartletts Brook, there is little surface evidence of gypsum in the area. In 1985 the Nova Scotia Department of Mines and Energy drilled hole RC-85-1 approximately 1 km northeast of the surface occurrence (Carter and Bochner, 1986). This hole encountered a complex geological section with the Canso Group Watering Brook Formation apparently faulted on top of the Scotch Village Formation of the Pictou Group. Beneath the Scotch Village a complex sequence of B and C Subzone Windsor clastics, carbonates and evaporites was encountered to a final depth of 1057.6 m. This section is described in greater detail in Nova Scotia Department of Mines and Energy, Open File Report 86-040 (Carter and Bochner, 1986).



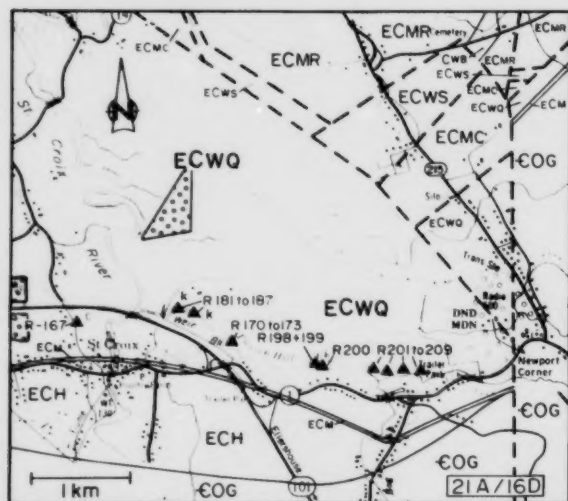
Geology after Stevenson, 1959

Figure 8-28. Location and geology of the Riverside Corner occurrence area. See Figures 8-1 and 8-3 for legend and location.

The surface sample of gypsum could possibly be either from the B or C Subzones (probably Wentworth Station or Pesquid Lake Formations) or even the Watering Brook Formation of the Canso Group. There is little potential for economically interesting gypsum or anhydrite in the Riverside Corner area.

ST. CROIX (0025)
 NTS 21A/16D
 UTM 419800 E 4979300 N

Located 8 km southeast of the Town of Windsor, the St. Croix area extends from the St. Croix River on the west to Newport Corner on the east (Fig. 8-29). Most of the area is underlain by the sulphate dominated White Quarry Formation which is underlain by the Horton Group to the south (Moore and Ferguson, 1986).



Geology after Moore and Ferguson, 1986; Moore, 1989
 Fundy Gypsum (see simple)

Figure 8-29. Location and geology of the St. Croix occurrence area. See Figures 8-1 and 8-3 for legend and location.

Nova Scotia Department of Mines, Annual Reports from the early 1900s mentioned a quarry in the Ellershouse area, however no production records have been found to substantiate these reports. A small portion of this area is held by the Fundy Gypsum Company. Domtar Gypsum holds rights to another small section (Domtar Gypsum, confidential company report).

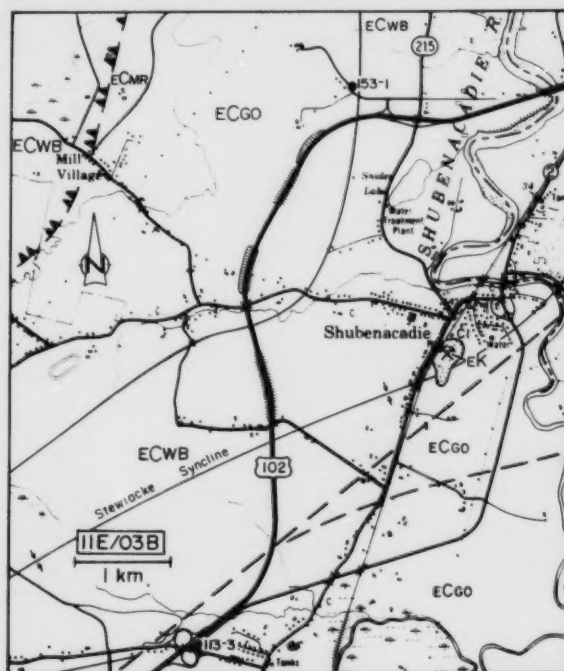
Numerous surface exposures can be found in this area especially along Weir Brook and the St. Croix River. Anhydrite dominates these outcrops with gypsum occurring along fractures and as a thin rind on the top of the anhydrite. Drilling by Domtar Gypsum in the area has substantiated this style of hydration in the middle of the area (Domtar Gypsum, confidential company report).

This area is remote enough to permit possible quarry development, however there appears to be insufficient hydration to allow substantial gypsum

reserves. Should anhydrite become a more sought after commodity then the St. Croix area will become attractive.

SHUBENACADIE (0141)
 NTS 11E/03B
 UTM 466000 E 4993000 N

The Shubenacadie occurrence area is located in the vicinity of the Village of Shubenacadie, Hants County (Fig. 8-30). Information on this area consists of two deep drillholes 6 km apart, both of which intersected gypsum and anhydrite horizons.



Geology after Giles and Bohner, 1982

Figure 8-30. Location and geology of the Shubenacadie occurrence area. See Figures 8-2 and 8-3 for legend and location.

Geological mapping by Giles and Bohner (1982) placed this area along the western side of the north-easterly trending axis of the Shubenacadie Basin. Much of the area is underlain by interbedded clastics with minor sulphates of the Canso Group Watering Brook Formation which overlies the Upper Windsor clastics, carbonates and sulphates of the Green Oaks Formation.

St. Joseph Explorations Ltd. drilled hole 113-3 for base metal in 1974 and 153-1 in 1975, in search of potash (St. Joseph Explorations Ltd., 1975). Both holes penetrated through the Green Oaks and MacDonald

Road Formations (Giles and Boehner, 1979); 113-3 stopped near the top of salt and 153-1 penetrated through the Stewiacke Formation before stopping in the basal anhydrite of the Carrolls Corner Formation at 681.8 m.

Information from these holes is of geological interest only. Continuity of sulphate horizons well into the Shubenacadie Basin as well as their relationship with the carbonate and halite units found in the deeper portions of the Basin can be observed. These observations may be useful towards basin margins where hydration of the anhydrite units of the MacDonald Road and Carrolls Corner Formations may become of economic interest (i.e. East Milford (0134), Halifax County, and related deposits).

SOUTH MATTLAND (0146)

NTS 11E/03C, 11E/06B

UTM 463440 E 5012550 N

The South Maitland occurrence area is located 17 km southwest of the Town of Truro, Colchester County (Fig. 8-31). It consists of a number of exposures including two sites where some gypsum and anhydrite appear to have been extracted at some time in the past. Approximately 19 305 t of plaster were produced at

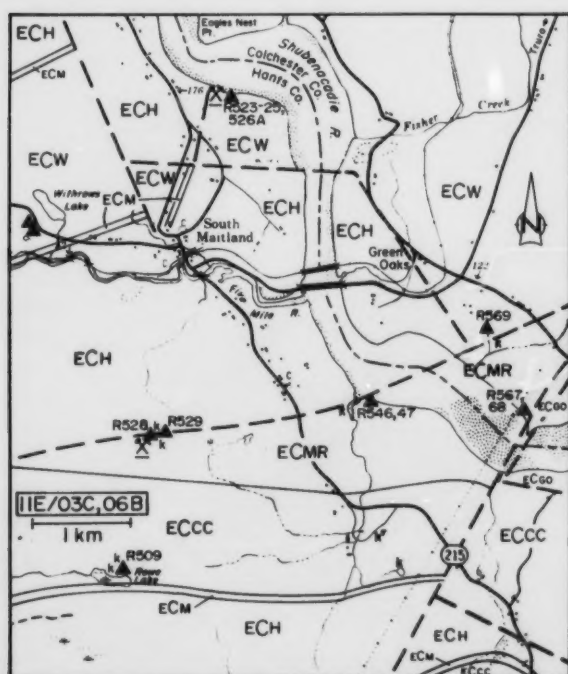


Figure 8-31. Location and geology of the South Maitland occurrence area. See Figures 8-1, 8-2 and 8-3 for legend and location.

Maitland between 1872 and 1879 (Nova Scotia Department of Mines, Annual Reports, 1873-1880). The most likely location for this production would be an old quarry site on the western bank of the Shubenacadie River just south of Eagles Nest Point.

This area straddles the boundary between regional geological mapping carried out by Giles and Boehner (1982) to the south and that by Stevenson (1958) to the north. Stevenson (1958) distinguished the basal carbonates Pembroke (not shown on map) and Macumber Formations and differentiated the Windsor Group into upper and lower parts. Much of the gypsum and anhydrite seen in this area belongs in the Carrolls Corner Formation with the exception of a few outcrops on both sides of the Shubenacadie River found south of the new highway bridge which Giles and Boehner (1982) placed in the MacDonald Road Formation. The area appears to be highly faulted with most contacts being faulted. Where this is not the case the sulphate-dominated Carrolls Corner Formation is underlain by the carbonates of the Macumber Formation which are underlain by Horton Group clastics.

The southernmost exposure in the South Maitland area can be found just north of Rowe Lake, where a large 7 m high head of fine grained, white gypsum can be seen. Moderate karst topography is also present to the north and west of the outcrop for a short distance. Rowe Lake is probably a dissolution feature lying along the base of the Carrolls Corner Formation. Approximately 1300 m north of Rowe Lake, an area of karst topography as well as a small abandoned quarry can be found in the woods. It appears as if some stripping had been undertaken and a small tonnage of gypsum removed, however, this site was never developed further. One possibility may be that the light grey, variably silty gypsum found here, which is probably part of the MacDonald Road Formation, was not white enough to be salable in the 1800s when gypsum was produced in this area. Similar units occur along strike to the east on both sides of the Shubenacadie River where interbedded sulphates, carbonates and clastics occur.

North of Five Mile River, two more outcrop areas can be found, both of which appear to belong to the Windsor Group Carrolls Corner Formation. The first is a series of rounded heads of light grey, fine grained gypsum with abundant selenitic crystals found along a steep bank 200 m southwest of Withrows Lake. The second is the old quarry site on the western bank of the Shubenacadie River. Stevenson (1958) believed this to be part of a fault-bound block of Windsor Group. The quarry is roughly horseshoe shaped, open to the north towards the River. The quarry section consists of white

to light grey, fine grained, massive to nodular, mosaic gypsum. Intermixed, light brown silt is common in part to minor throughout. Hydration appears to extend below the high tide mark. The quarry area covers approximately 3 ha and heads up to 20 m in height still remain. This thick sulphate unit is apparently underlain by a dark grey limestone, massive to laminated at base which is up to 5 m thick. The limestone is underlain by a light to medium grey, massive, selenitic gypsum and the section is concealed below. Horton Group clastics are observed across a fault 300 m northwest of the quarry area.

Despite the number and quality of gypsum exposures in the South Maitland area, it is not considered a good candidate for future development. Most of the known exposures are of the Carrolls Corner Formation and appear to be hydrated to shallow depths. Although the highly faulted geology of the area may promote deeper hydration, it also limits the lateral extent and potential minability of these units.

STANLEY (0184)

NTS 11E/04C

UTM 424000 E 4998000 N

The Stanley occurrence area is located 10 km south-southeast of the Village of Walton, Hants County (Fig. 8-32). Regional geological mapping by Stevenson (1959) indicated that the entire area is underlain by clastics

belonging to the Pictou Group Scotch Village Formation. Gypsum has been encountered at depth in exploration drillholes.

Scurry-Rainbow Oil Ltd. drilled a series of four rotary holes in this area in 1966 as part of a regional sulphur exploration program (Kawase, 1967). Holes SR5-2 and SR5-3 penetrated through the Scotch Village Formation into interbedded clastics, carbonates, calcium sulphate and halite horizons of the Windsor Group. The drillholes were not cored and chip samples of lithologies were used to log the strata. Boehner (1986) discussed this drilling in the Stanley salt occurrence writeup.

With regard to gypsum and anhydrite, the interbeds described in Scurry Rainbow's report (Kawase, 1967) are generally <10 m thick although one in hole SR5-3 is 27.4 m thick. Unfortunately, the top of this unit is at a depth of 228.6 m. This area is strictly of geological interest for gypsum and anhydrite.

STIRLING BROOK (0185)

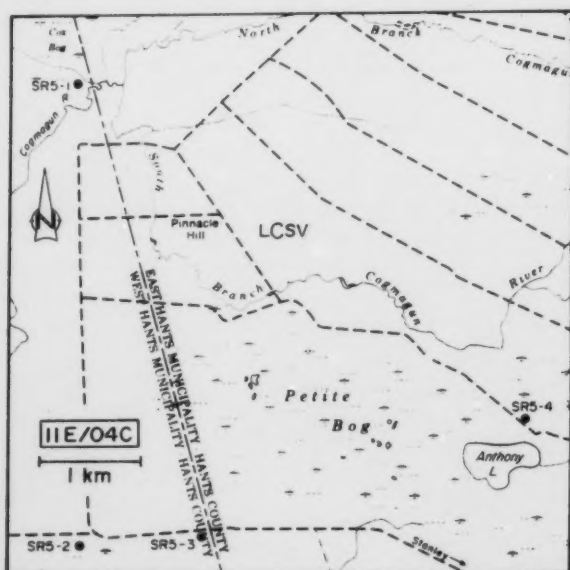
NTS 11E/05A

UTM 456500 E 5017500 N

The Stirling Brook occurrence area is located 4 km west of the Village of Maitland, Hants County (Fig. 8-33). Regional geological mapping by Weeks (1946a) indicated that the immediate vicinity is underlain by Windsor Group strata. Outcrops are rare and one small area of moderate karst topography occurs just west of the Selma Road, 1.4 km southeast of Route 215. Two diamond-drill holes, put down by the Nova Scotia Department of Mines in 1962, intersected some gypsum and anhydrite at depth (Nova Scotia Department of Mines, 1962).

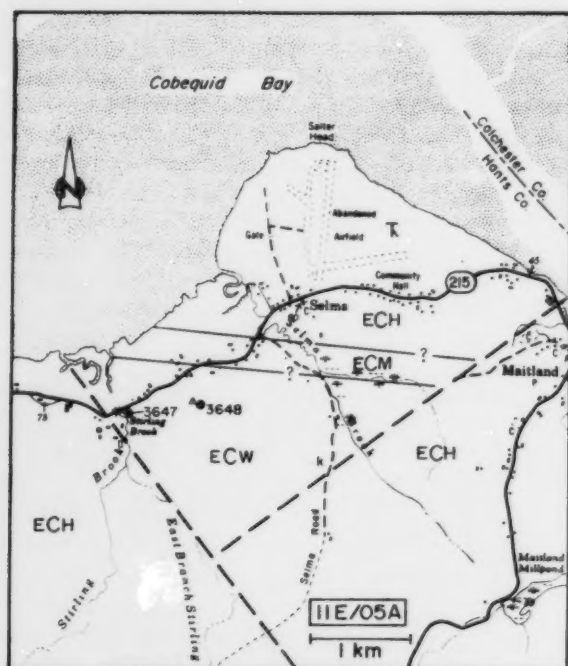
Hole 3647 (T.D. 141 m) was drilled immediately east of Stirling Brook and hole 3648 (T.D. 137 m) was drilled 800 m east of the Brook. Both encountered thick sequences of red and grey shales with thin gypsum and anhydrite interbeds. No stratigraphic interpretation of these holes appears to have been undertaken, however they were probably drilled in the Upper Windsor Group or even the Watering Brook Formation of the overlying Canso Group. Outside of the triangular block of Windsor Group as mapped by Weeks (1946a), the rest of this area is underlain by clastics of the older Horton Group.

The Stirling Brook occurrence is of geological interest only. The calcium sulphate units, seen in drilling, are thin and separated by thick clastic units. Karst topography in the area probably reflects a gypsum bed below the surface, but the limited areal extent of the karst and lack of other evidence suggests that it is small in size and holds little potential for development.



Geology after Stevenson, 1959

Figure 8-32. Location and geology of the Stanley occurrence area. See Figures 8-1 and 8-3 for legend and location.



Geology modified after Weeks, 1946a

Figure 8-33. Location and geology of the Stirling Brook occurrence area. See Figures 8-1 and 8-3 for legend and location.

SUMMERVILLE (0053)

NTS 21H/01A

UTM 407100 E 4994700 N

The Summerville area is located 23 km north of the Town of Windsor, Hants County, on the eastern shore of the Avon River (Fig. 8-34). There are two separate occurrences in this area. One, in fault-bound rocks of the Miller Creek Formation, can be seen along the shore of the Avon River just south of the Village of Summerville where a number of gypsum outcrops can be seen. The second, just northwest of the Village, consists of a small basin of thick sulphates of the White Quarry Formation which are underlain by the Macumber Formation and clastics of the Cheverie Formation (Ferguson, 1983).

The gypsum outcropping along the shore was mapped by Ferguson (1983) in a highly faulted sequence with Horton Group clastics in contact with the interbedded sulphates, carbonates and clastics of the Miller Creek Formation. There appears to be little lateral extent to this section and therefore no opportunity for economic development.

The occurrence northwest of Summerville was intersected by two diamond-drill holes completed by

New Jersey Zinc Exploration Co. (Canada) Ltd. in 1966 (McMurray, 1966) and 1969 (Cunningham, 1969). Hole 2-S-69 passed through 427.8 m of sulphates before encountering the underlying Macumber Formation. The drill site area had an overburden thickness of 17.7 m and only the topmost 12.7 m of the basal sulphate was found to be gypsum. Additional work should be carried out along the White Quarry Formation-Cheverie Formation contact in the area east of these drillholes where it might be possible to develop a small quarry, should sufficient reserves exist.



Geology after Ferguson, 1983; Moore and Ferguson, 1986

Figure 8-34. Location and geology of the Summerville occurrence area. See Figures 8-1 and 8-3 for legend and location.

TENNYCAPE (0060)

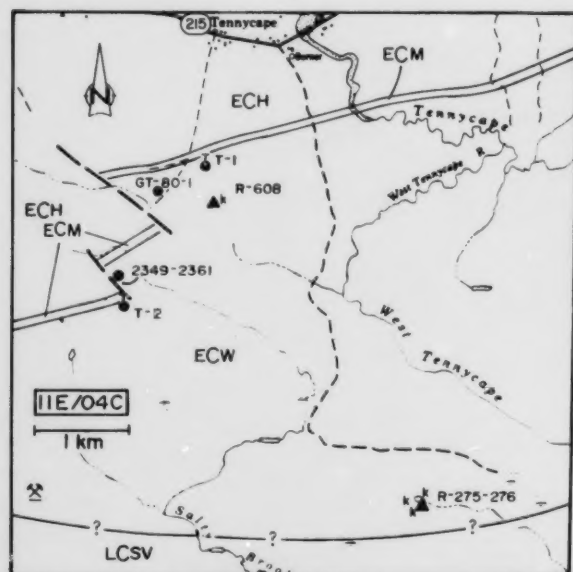
NTS 11E/04C

UTM 432600 E 5007800 N

The Tennycape occurrence area is located between 1 and 5 km south of the Village of Tennycape, Hants County (Fig. 8-35). Available information includes several areas of karst topography, some with outcrop, as well as a number of diamond-drill holes.

Regional geological mapping by Weeks (1946b) and Stevenson (1959) established that much of this area is underlain by undivided units of the Windsor Group. The northern boundary of the Windsor Basin runs

northeastward through the northern part of the Tennycape area and it deepens to the south. These units are underlain by Horton Group clastics to the north and are overlain by much younger clastics of the Pictou Group Scotch Village Formation to the south. Due to the lack of outcrops in the area, Stevenson's (1959) Windsor/Scotch Village boundary is uncertain. Drillhole evidence in an area just to the south suggests that the geology of this portion of the basin may be structurally complex.



Geology modified after Weeks, 1946b; Stevenson, 1959

Figure 8-35. Location and geology of the Tennycape occurrence area. See Figures 8-1 and 8-3 for legend and location.

Two widely separate exposures of gypsum have been found in this area; both appear to have been quarried, on a small scale, for local use at some time in the past. A small face 7 x 3 x 10 m can be found 1900 m south-southwest of the bridge over the Tennycape River on Route 215. Here, light to medium grey, medium- to coarse-grained gypsum is found on the northern side of an area of light karst 50 m north-south by 100 m east-west. The second area is found 3800 m to the south-southeast where gypsum heads can be seen immediately south of two east-west elongate ponds. An area of moderate to heavy karst covers approximately 2 ha south of the ponds. At the northeastern corner of the karst area, heads up to 8 m high and 20 m long contain white to light brown, fine grained, high purity gypsum.

B. A. Parsons Ltd. used a Nova Scotia Department of Mines drill to explore for gypsum at Stevens Mountain (historical name) in 1956 (Province of Nova

Scotia, 1957c). Thirteen holes were put down, eight of which hit bedrock. The best hole (2354) collared and stopped in grey gypsum at a depth of 30 m. Accurate locations are not available for these holes, but they are believed to be located near the Windsor-Horton boundary. In 1978, Preuvier Mines Ltd. drilled two inclined diamond-drill holes (T-1 and T-2) which collared in the Windsor and penetrated into the Horton Group along the northern margin of the Basin. Both intersected gypsum and anhydrite sections, however these are overlain by clastic horizons of 20 m or greater thickness (Hudgins, 1978). Gulf Minerals Canada Ltd. also drilled an inclined exploration drillhole (GT-80-1) in the area in 1980 (Boyd, 1981) which encountered 84.3 m of gypsiferous section overlain by 30.9 m of overburden. The true thickness and purity of the section is unknown as it is in part anhydrite.

Insufficient information is presently available to properly assess the potential of the Tennycape area for gypsum and anhydrite. The evidence indicates that some blocks of high purity gypsum can be found near surface, however the complex structure would probably hinder the discovery of extensive bodies of gypsum that might be quarried on a large scale. Further work should be undertaken to determine the extent of resources adjacent to those known exposures. The nearest point of shipment is located at Walton which is 10 km to the west.

THREE MILE PLAINS (0009)

NTS 21A/16D

UTM 410870 E 4978945 N

This area is located 2.5-3 km south-southeast of the Town of Windsor, Hants County, and extends from Martock in the west to the Gypsum Mines area in the east (Fig. 8-36). Bedrock is dominated by the White Quarry Formation which is overlain by the Miller Creek, Wentworth Station and Pesquid Lake Formations to the north and west and underlain by Horton Group rocks to the south.

A limited number of drillholes (Saarberg Interplan Canada Ltd., confidential files) have penetrated the sulphate section in the area; they indicate that a thickness in excess of 170 m is attained, most of which is anhydrite. Numerous outcroppings and minor karst can be seen here as can several abandoned quarries, the DeWolfe Quarry on Lebreau Creek, the Parsons and Meadow Pond Quarries beside the 101 Highway and the Wilkins and Windsor Plaster Quarries. Quarries still under operation in part of the area are the Wentworth Dark Quarry and Quarry 4A of the Fundy Gypsum Company's Wentworth Creek operations (0182).

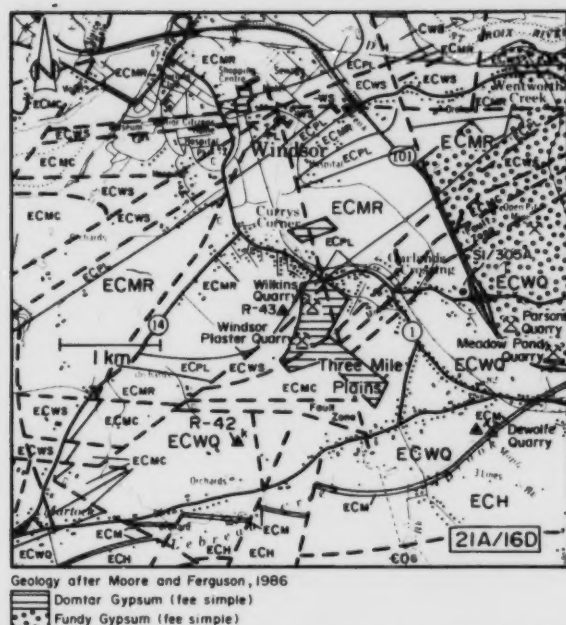


Figure 8-36. Location and geology of the Three Mile Plains occurrence area. See Figures 8-1 and 8-3 for legend and location.

Little opportunity exists for additional quarry development in this area due to the increasing number of houses being built here. Production from the Fundy Gypsum Quarries at Wentworth appears to be small and only of high purity gypsum and anhydrite taken from the White Quarry Formation.

TULLOCK BROOK (0138)
NTS 11D/13D
UTM 451500 E 4979500 N

The Tullock Brook occurrence area is located 5-6 km northwest of the Village of Enfield, Hants County (Fig. 8-37). Amax Exploration Inc. drilled a total of eight drillholes in this area in 1974 as part of a regional base metal exploration program (Lebel, 1974c). Surface exposures of gypsum and some karst topography can also be seen here, along the eastern side of the valley of Tullock Brook.

Regional geological mapping by Giles and Bochner (1982) indicated that this area lies along the northerly trending, western margin of the Shubenacadie Basin. Much of the area is underlain by the sulphate dominated Carrolls Corner Formation which is underlain to the west by the Gays River basal Windsor Group carbonate which is underlain by Horton Group clastics and Meguma Group metamorphic rocks. The Carrolls Corner Formation is overlain to the east by interbedded

carbonates, sulphates and clastics of the MacDonald Road Formation which is overlain by similar units of the clastic dominated Green Oaks Formation.

A series of small heads of fine grained, white gypsum 1-3 m high and up to 20 m long can be found near the headwaters of Tullock Brook. Karst topography, with moderate to small sinkholes, extends north-northeast of the outcrop for 700 m, paralleling the Carrolls Corner-Gays River Formations contact. Five of Amax's eight drillholes encountered the basal sulphate. The thickest hydration section intersected was only 18.0 m overlain by 28.3 m of overburden. Unfortunately, no drillhole information is available from the MacDonald Road Formation in this area and this section shows good potential along strike to the north in the Uniacke Brook occurrence area (0065).

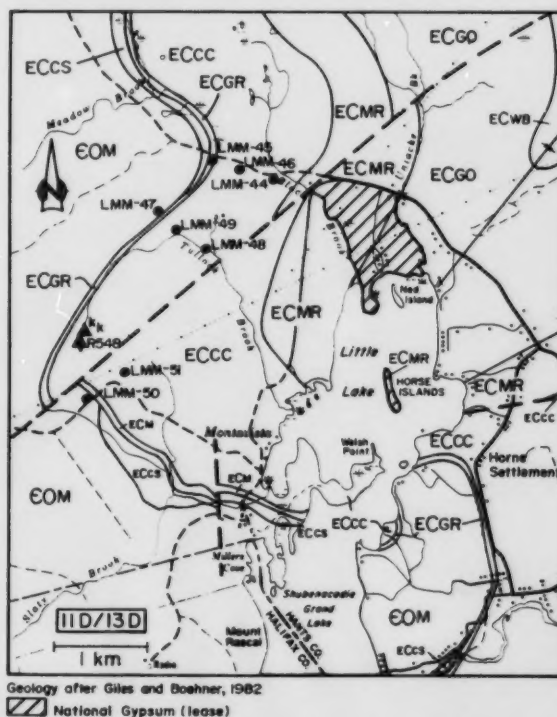
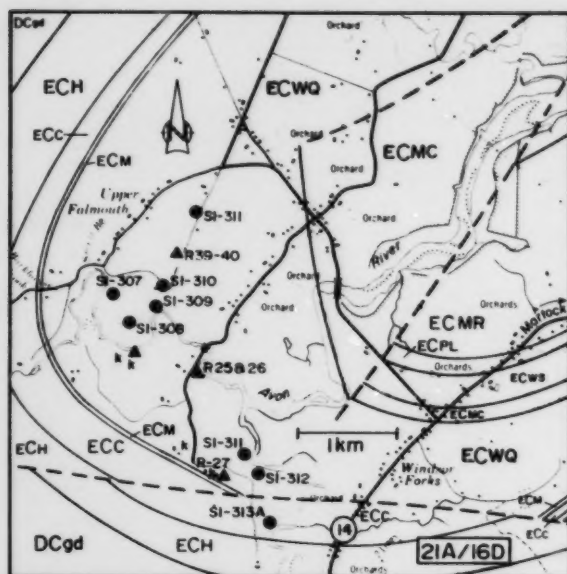


Figure 8-37. Location and geology of the Tullock Brook occurrence area. See Figures 8-2 and 8-3 for legend and location.

The Tullock Brook area is undeveloped yet within 50 km of the port of Halifax. As a result, this area warrants additional investigation both along the basal contact of the Carrolls Corner Formation and near the Carrolls Corner-MacDonald Road Formations contact where a hydration situation similar to that at East Milford (0134), Halifax County, may exist.



Geology after Moore and Ferguson, 1986

Figure 8-39. Location and geology of the Upper Falmouth occurrence area. See Figures 8-1 and 8-3 for legend and location.

URBANIA (0145)

NTS 11E/03C

UTM 467000 E 5006000 N

The Urbania occurrence area is located 10 km northwest of the Town of Stewiacke, Colchester County (Fig. 8-40). No drillhole information is available on the sulphate horizons in Windsor Group in this area, however extensive outcrops as well as karst topography can be found on both sides of the Shubenacadie River.

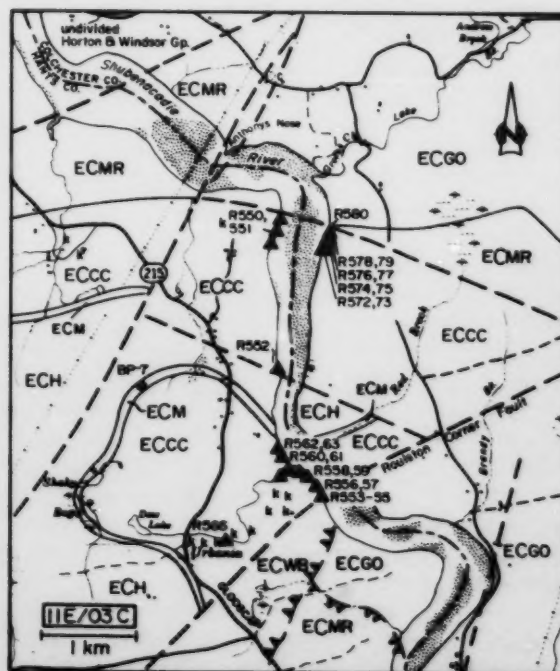
Regional geological mapping by Giles and Bochner (1982) indicated that much of this area is underlain by the sulphate dominated Carrolls Corner Formation. Many of the contacts noted by Giles and Bochner (1982) are faulted along northwest-southeast or northeast-southwest faults. The Carrolls Corner Formation is underlain or in fault contact with clastics of the Horton Group to the west and in fault contact with interbedded carbonates, clastics and sulphates of the MacDonald Road and Green Oaks Formations to the north and east. Finally, the Carrolls Corner Formation is also believed to be in fault contact to the south with the much younger Watering Brook Formation of the Canso Group across the Roulston Corner Fault.

Extensive karst topography with common gypsum heads can be found between Route 215 and the Shubenacadie River in the southern portion of this area. Gypsum and anhydrite are also exposed along the River

at this point. Most of the gypsum is fine grained, white with minor intermixed dark grey carbonate material. The anhydrite is generally light blue grey, fine grained and massive. Outcrops are generally low lying with occasional heads up to 5 m high and can be continuous over distances of up to 200 m. Usually only the upper one-third of exposed outcrops is seen to be hydrated to gypsum.

In the northern portion of the Urbania occurrence area, a discontinuous outcrop area approximately 340 m long can be found along the eastern side of the Shubenacadie River. Outcrops consist of fine grained, white gypsum, with some remnant blocks of light blue, fine grained anhydrite, overlying massive, fine grained, light blue anhydrite. Small, white, borate nodules are locally abundant along the exposure. Dark grey limestone is commonly intermixed with the gypsum and anhydrite and where still intact limestone interbeds appear to be flat lying. Selenitic zones, which possibly represent fault zones, are also present. Where the anhydrite is fine grained and massive, only the top third of the outcrop is hydrated to gypsum.

The sulphates here are massive and very pure and appear to belong to the Carrolls Corner Formation. However, hydration in outcrop is restricted to the



Geology after Giles and Bochner, 1982

Figure 8-40. Location and geology of the Urbania occurrence area. See Figures 8-2 and 8-3 for legend and location.

uppermost surface of the thick basal sulphate. Deeper hydration is in evidence along the basal contact and near major faults, but is not extensive enough to yield economically interesting volumes of gypsum. High purity gypsum and anhydrite, as well as borate nodules, should make this area of greater interest to mineral collectors and stone carvers.

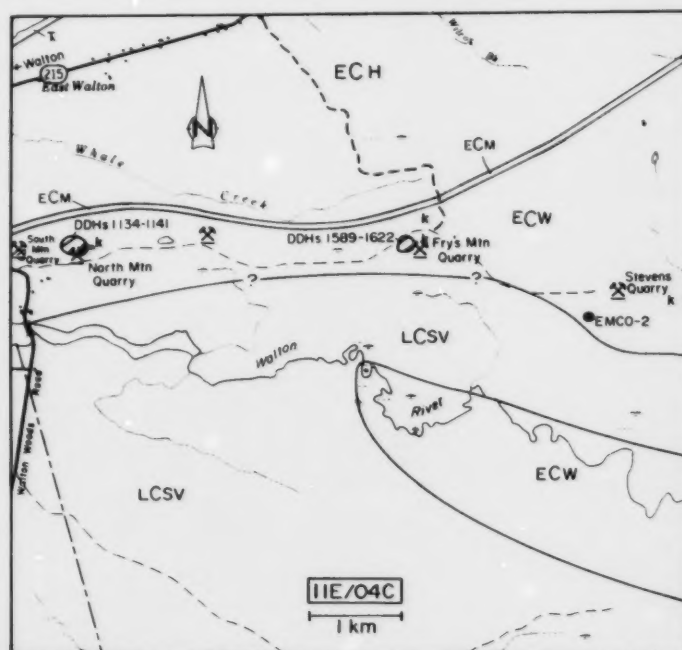
WALTON (0179)
NTS 11E/04C
UTM 426600 E 5008500 N

The Walton occurrence area extends east from the Village of Walton for a distance of 7 km along the Horton-Windsor contact (Fig. 8-41). This area was actively quarried for a period of about 150 years between the early 1800s and 1966 when activities finally ceased.

Available historical documents are incomplete in recording the production of gypsum and anhydrite from the Walton Quarries prior to 1872. Jennison (1911) indicated that gypsum had been produced for export in the area for a century prior to his investigations. Actual production figures are difficult to determine because they were combined with production from quarries in the Cheverie area. Several different companies ran the Quarry operations over the years (King, 1985). National Gypsum Canada Ltd. was the last operator between 1936 and 1971 when a number of different sites were quarried in the area. Early production centred around the North and South Mountain Quarries located just east of the Walton Woods Road until 1948 when a new quarry was opened 800 m east of these Quarries. Two years later another quarry was opened at Frys Mountain 3.2 km east of the original quarries and by 1952 all production from the Walton area was coming out of Frys Mountain. Finally,

a small quarry (Stevens Quarry) was developed 1.6 km east of Frys Mountain in 1957.

National Gypsum began producing gypsum at East Milford (0134), Halifax County, in the late 1950s and gradually reduced production elsewhere. By 1965, all gypsum production at Frys Mountain ceased and only anhydrite continued to be produced from the North Mountain Quarry. Finally in 1971, all large-scale production of gypsum and anhydrite ceased in the Walton Quarries. Since that time, small amounts of material have been taken from waste piles for local use as road fill.



Geology modified after Stevenson, 1959

Figure 8-41. Location and geology of the Walton occurrence area. See Figures 8-1 and 8-3 for legend and location.

Regional geological mapping of the area by Stevenson (1959) indicated that the northern edge of the Windsor Basin runs roughly east-west through the Walton area, turning to the northeast past Frys Mountain. More recent work (Boyle, 1972) suggested that the Horton-Windsor contact geology is more complex along this edge of the Basin. Much of the area is underlain by the calcium sulphate-dominated units of the Lower Windsor Group which overlie the carbonate Pembroke and Macumber Formations to the north. These in turn overlie clastics of the

Horton Group. Clastics of the Late Carboniferous Scotch Village Formation of the Pictou Group unconformably overlie the Windsor strata to the south, however a lack of outcrop or drillhole information in this area makes it difficult to accurately locate the contact.

Significant areas of karst topography can be found adjacent to all the old quarry sites at Walton. The largest is immediately east of the Stevens Quarry where heavy to moderate karst with rounded exposures extends several hundred metres east of the Quarry. Several drill-

ling programs have been undertaken in this area in the past; two in the areas of the quarries to delineate reserves and one to explore for barite. Eight holes were put down by National Gypsum in the North Mountain Quarry in 1946 (DDHs 1134-1141) (Province of Nova Scotia, 1947a); and, in 1950, the company drilled 34 holes in the area of the Frys Mountain Quarry (DDHs 1589-1622) (Province of Nova Scotia, 1951). Finally, in 1969 the Magnet Cove Barium Corp. drilled a single hole just southwest of the Stevens Quarry (EMCO-2) (Magnet Cove Barium Corp. Ltd, 1967-1969).

Most of these holes encountered interbedded gypsum and anhydrite with clay, limestone and shale units. Lacking exact locations and elevations, it is impossible to construct geological sections from National's drilling, however field observations indicate that numerous interbeds of carbonates and fine grained clastics as well as anhydrite must have made large scale gypsum quarrying difficult at Walton.

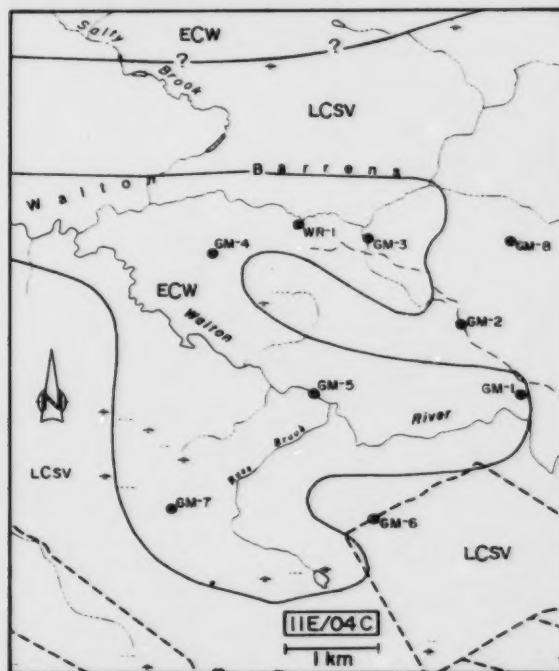
Although much of the quarried area at Walton contains interbedded carbonate and clastic horizons and significant remnant anhydrite lenses, not enough is known about the stratigraphy and structural geology of the area to rule out its development potential. Additional drilling should be undertaken at Walton to determine whether reserves exist which might be amenable to a large scale mining operation. Possible shipments can be made out of the wharf at Walton which could accommodate vessels up to 6400 t.

WALTON RIVER (0181)
NTS 11E/04C
UTM 433000 E 5005640 N

The Walton River occurrence area is located 10 km southwest of Walton, Hants County (Fig. 8-42). Stevenson (1959) mapped this area as an erosional 'window' underlain by Windsor Group strata which are surrounded (and overlain) by much younger clastics of the Pictou Group Scotch Village Formation. Outcrops are very sparse over this area and, even with the evidence from 13 widely spaced drillholes, geological contacts are assumed.

Magnet Cove Barium Corp. Ltd. drilled a series of five holes in this area in 1969 in search of base metals (Magnet Cove Barium Corp. Ltd. 1967-69). Holes WRX-1 to WRX-4 were all shallow and exact collar locations are unknown. Hole WR-1 was drilled to a depth of 609 m where it stopped in salt. Gulf Minerals Canada Ltd. drilled eight holes in this area in 1975 as

part of a regional base metal exploration program (Carpenter, 1975). Boehner (1977a) undertook a stratigraphic interpretation of the deepest of these holes (GM-5) which penetrated to a depth of 287 m and bottomed in salt. He concluded that this hole contained a faulted and tightly folded sequence containing a single section which is repeated a total of 12 times. Boehner (1986) suggested that this unit belongs to the B Subzone and that the structure may be related to gravity sliding. Details of the stratigraphy of the other drillholes are unknown, however the interbedded cyclic sequences of carbonates, redbeds and evaporites are typical of Cycles 2 to 5. Further information on the area can be gained from Boehner (1986).



Geology after Stevenson, 1959

Figure 8-42. Location and geology of the Walton River occurrence area. See Figures 8-1 and 8-3 for legend and location.

Most of the drillholes put down in the Walton River area encountered some gypsum and anhydrite. Unfortunately, most of these intersections are thin, steeply dipping and were made at depth. The most interesting hole was GM-3 where 14.6 m of gypsum is overlain by a similar thickness of overburden (Carpenter, 1975), however the structural complexity of the area as well as lack of other surface or subsurface evidence make this area a poor exploration target. The Walton River occurrence area is of geological interest only.

WENTWORTH CREEK (0182)
NTS 21A/16D
UTM 414000 E 4982000 N

Lewis and Holleman (1983) stated that quarries located at Wentworth Creek, Hants County, 3 km east of the Town of Windsor (Fig. 8-43) have produced gypsum and anhydrite for over 150 years, however, production records, as well as ownership details, are not clear before the early 1900s.

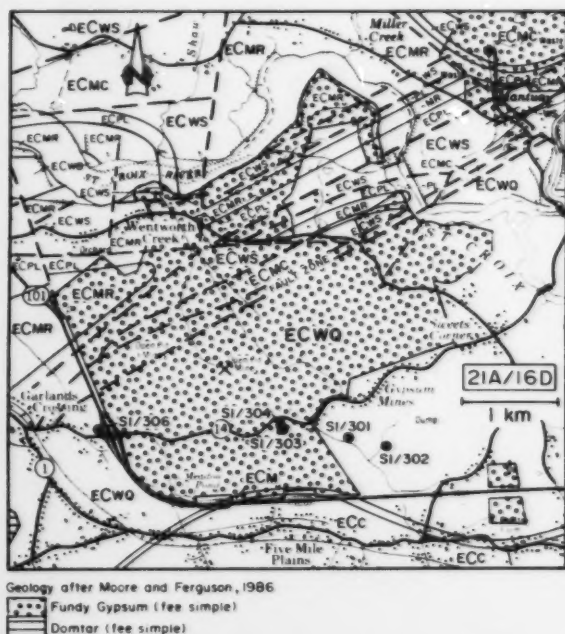


Figure 8-43. Location and geology of the Wentworth Creek occurrence area. See Figures 8-1 and 8-3 for legend and location.

Prior to 1875 operations here were run by the Wentworth Gypsum Co. which became the Canadian Gypsum Co. in 1926 and subsequently the Fundy Gypsum Company Ltd. in 1962 (King, 1985). Intermittent records, as well as several quarries in the same area reported by the same company, made production figures even more difficult to determine, although a total figure in excess of 25 Mt would be conservative.

Production continues today under the Fundy Gypsum Company Ltd. Most of the gypsum produced by Fundy is from a newer quarry located 4 km to the northeast at Miller Creek (0183). The Wentworth Creek Quarries still produce high purity white gypsum for specialty plasters and anhydrite products for agriculture and cement industries. The Wentworth operation is unusual in that a heavy media liquid sink-float plant is

used to separate gypsum from anhydrite. Although production figures are unclear because totals are combined with those of the Miller Creek Quarry before being reported to the Department, the Wentworth Quarries produce about 200 000 t of gypsum and anhydrite each year. Products are transported from the site by rail 16 km to the Company's loadout facilities at Hantsport. Company owned and chartered vessels carry gypsum and anhydrite to various points in the United States from Boston, Massachusetts, to Houston, Texas.

Recent geological mapping by Moore and Ferguson (1986) indicated that much of the Wentworth area is underlain by the calcium-sulphate dominated White Quarry Formation. These units are underlain at depth by the basal Windsor carbonate Macumber Formation which is in turn underlain by clastics of the Horton Group. The White Quarry Formation is in fault contact with the overlying interbedded clastics, carbonates and calcium sulphate bearing Miller Creek and Wentworth Station Formations. Although these Formations are complexly deformed, some portions of them have been mined for gypsum at Wentworth Creek in the past.

In spite of the long history of gypsum and anhydrite production in this area there has been an absence of any other mineral exploration over the lands owned by Fundy Gypsum. Although some theses pertaining to certain carbonate horizons found in the quarried areas are available to interested parties, geological reports or deep drillhole records are not available. Some shallow drilling was carried out in the area by government drills in the 1910s and 1920s, however these are of little use in defining the detailed geology of the White Quarry and Miller Creek Formations because the holes exact locations and collar elevations are unknown.

Typically, hydration of the massive calcium sulphate horizons of the White Quarry is limited to depths of a few metres down to 20 m as observed in other areas. This can increase to depths in excess of 50 m in conjunction with faulting or porous interbedded horizons. Although the volumes of gypsum available in these units cannot be estimated, the gypsum quality is known to be of high purity and white in colour which is similar to McKay Section (0056).

Gypsum reserve estimates at Wentworth in Fundy Gypsum's Quarry are unavailable, however it is probable that there is sufficient high purity stone to maintain current low rates of production for many years to come. Anhydrite reserves available beneath the Quarry floor would easily exceed 150 Mt based in part on using deep drilling carried out by Saarberg Interplan Canada Ltd. just south of the Quarries to approximate the thickness

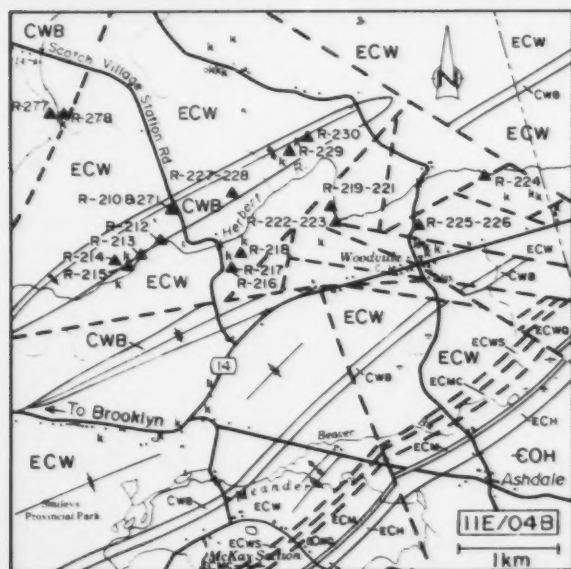
producer. Jennison (1911) mentioned the Pellow Quarry, abandoned in 1911, which produced '500,000 tons'.

Recent geology mapping Moore and Ferguson (1986) indicated that this area is structurally complex, underlain by fault-bound blocks of interbedded gypsum, carbonates and clastics of the Miller Creek and Wentworth Station Formations of Cycle 2 (B Subzone) and the Murphy Road Formation of the Upper Windsor Group.

Little or no economic interest exists in this area.

WOODVILLE (0026)
NTS 11E/04B
UTM 423700 E 4987000 N

The Woodville area is located 5 km northeast of the Village of Brooklyn, Hants County (Fig. 8-46). A recently published preliminary geology map of the area



Geology after Moore, 1986

Figure 8-46. Location and geology of the Woodville occurrence area. See Figures 8-1 and 8-3 for legend and location.

(Moore, 1986) showed moderate deformation with a series of synclines, anticlines and many faults. The underlying rocks are dominated by the Wentworth Station, Pesaquid Lake and Murphy Road Formations of the Windsor Group (included in undivided Windsor Group on Figure 8-46) as well as the Watering Brook Formation of the Canso Group (Moore, 1986).

Most of the gypsum outcrops found in this area have been mapped by Moore (1986) as belonging to either the Pesaquid Lake or Watering Brook Formations. The most extensive area of karst topography lies south of the Herbert River and east of the Scotch Village Station Road.

This area warrants further investigation as a potential location for a small sized gypsum deposit. Some previous drilling (Moore, personal communication) north of Herbert River encountered much interbedded red siltstone between gypsum beds in the Watering Brook Formation.

Domtar Gypsum holds gypsum rights on a small block of land on the western end of this area (Domtar Gypsum, confidential company report). Other companies have worked in the area in the past, but presently do not hold any rights.

CHAPTER 9. INVERNESS COUNTY

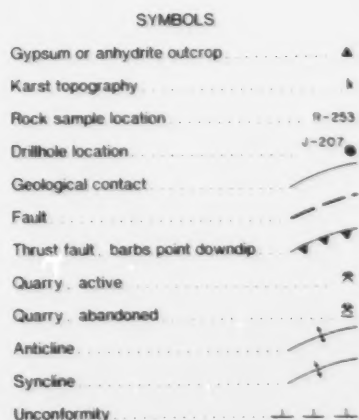
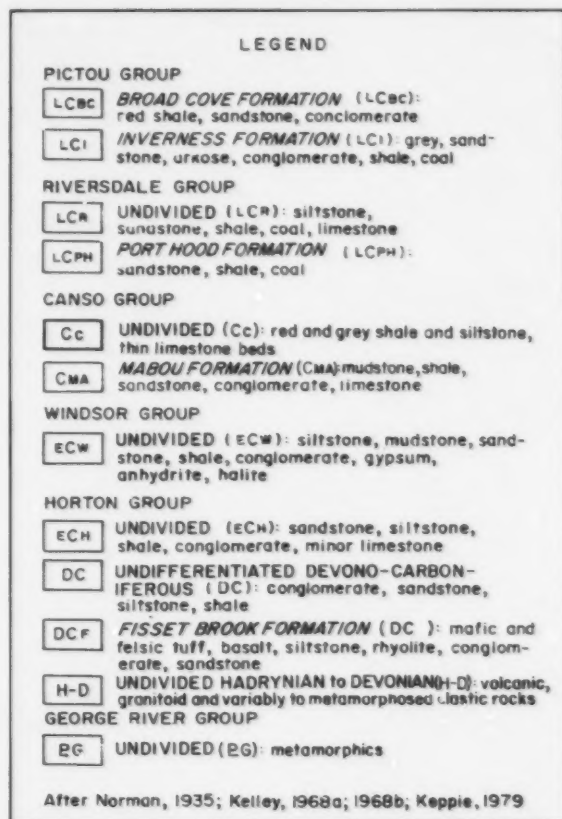


Figure 9-1. Geological legend for Inverness County gypsum and anhydrite occurrence maps.



Figure 9-2. Location map for Inverness County gypsum and anhydrite occurrences by reference number.

ALBA (0031)
NTS 11F/14D
UTM 652000 E 5087000 N

The Alba area is in the central portion of an extensive Carboniferous basin which runs from Port Hawkesbury in the southwest to Baddeck in the northeast (Fig. 9-3). Little detailed geological mapping or compilation has been undertaken to date in this basin which is dominated by rocks of the Windsor and Canso Groups (Kelley, 1968a; Weeks, 1955). Generally the basin is

flanked by Devonian-Carboniferous intrusive rocks in the North Mountain to the southeast and Hadrynian metamorphic and intrusive rocks to the northwest in the Creignish Hills.

Geological mapping in the Alba area by Rio Tinto Canada Exploration Ltd. (Blakeney, 1974) indicated it to be, for the most part, underlain by carbonates and evaporites of the Windsor Group. Major Cycles 1 and 2 (A and B Subzones) were found south of the Canadian National Railroad and the Upper Windsor was found to the north of the Railroad. The northern portion of the area is underlain by clastic sedimentary rocks of the Mabou Formation.

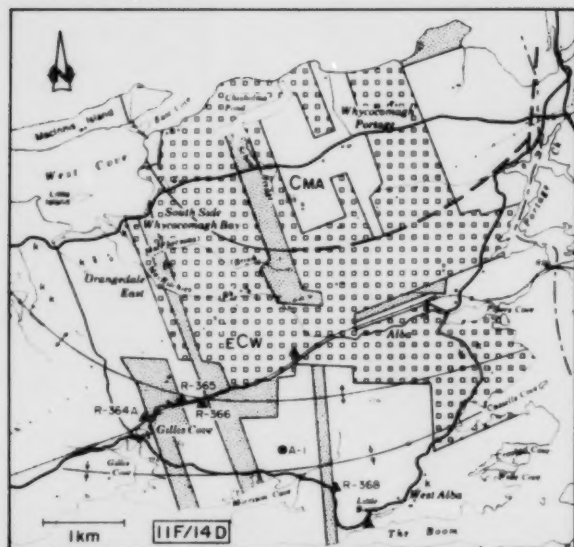


Figure 9-3. Location and geology of the Alba occurrence area. See Figures 9-1 and 9-2 for legend and location.

The strata in this area mainly dip to the north and northeast under the Mabou Formation clastics. Blakeney (1974) interpreted a series of broad anticlinal and synclinal folds trending roughly east-west through the area. Some small scale faulting was seen, but no major fault structures were encountered.

During 1957 and 1958 Allied Chemicals drilled 193 diamond-drill holes (5507 m) in this area. This drilling defined seven gypsiferous areas containing approximately 33.6 t of gypsum. These areas straddle the main line of the Canadian National Railway and show good economic potential. No drill logs are presently available for these holes.

In addition to these seven areas, numerous gypsum outcrops and sinkholes are known to exist in the Alba area. Also one diamond-drill hole, A-1, drilled by Rio Tinto Canada Exploration Ltd. in 1974 to the immediate south and east of the Allied areas, encountered 47.8 m of gypsum (at the top of the basal anhydrite of Major Cycle 1) under 18.3 m of overburden (Blakeney, 1974). The same geological situation will probably occur along strike both to the east and to the west.

Information available on this area is limited, however that which is available indicates good reserves of high quality gypsum with thin overburden. Open-pit mining could be possible in the area with good transportation access either by rail, road or ship. Most of the gypsum rights are currently controlled by Hanson Industries.

BIG BROOK (0039)

NTS 11F/14A

UTM 638400 E 5072700 N

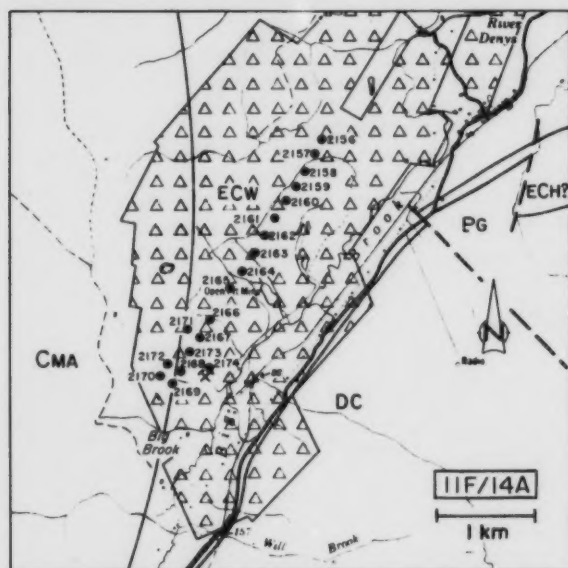
Big Brook has been the site of Georgia-Pacific Corporation's open-pit gypsum operation since 1962 (Fig. 9-4). The quarry is being phased out as the company moves much of its production to a new quarry at Sugar Camp (0041), Inverness County. Over the past 25 years the company has produced a total of 15.4 Mt of gypsum (by the end of 1986). The average production has been 614 000 t per annum, with the maximum of 891 691 t produced in 1985 (Nova Scotia Department of Mines and Energy, Annual Reports, 1963-1988).

The Big Brook deposit lies near the southeastern margin of an extensive Carboniferous basin which runs from Port Hawkesbury in the southwest to Baddeck in the northeast. The basin is dominated by rocks of the Windsor and Canso Groups which are flanked by Devonian-Carboniferous intrusives to the southeast (North Mountain) and Hadrynian metamorphics and intrusives in the Creignish Hills to the northwest (Kelley, 1968a; McCulloch, 1974b).

Although the quarry area has been extensively drilled, only a little information from a few of these holes is presently available. The available information shows the quarry area to be underlain by thick evaporites with interbedded clays and minor carbonates (Province of Nova Scotia, 1957c).

Overburden thickness is variable 6.1-24.5 m, typical of heavily karstified gypsum bodies, however gypsum, clay and limestone horizons also appear variable (Province of Nova Scotia, 1957c). Units are rarely

correlative between drillholes <150 m apart. Bochner (personal communication) suggests that, in this portion of this Carboniferous basin and probably in others, e.g. MacIntyre Lake (0016), (Giles, 1981b) large scale dissolution of the salt horizons in the Windsor has lead to collapse and disruption of all strata within and above the salt zones.



Geology modified after Kelley, 1968a; McCulloch, 1974b

△ Georgia-Pacific Corporation (fee simple)

Figure 9-4. Location and geology of the Big Brook occurrence area. See Figures 9-1 and 9-2 for legend and location.

All of the Big Brook area is underlain by thick anhydrite (Graham, personal communication) which probably belongs to the basal anhydrite of Cycle 1 (A Subzone) of the Windsor Group. The disturbed section observed at Big Brook probably belongs to the top of this Cycle and may contain some portion of the overlying Cycle 2 (B Subzone).

Georgia-Pacific Corporation is currently reducing its operations at Big Brook. Most of the land in and around the quarry site is held in fee simple by the company and it is its intent to retain possession of it at this time. Substantial volumes of high purity anhydrite are presently exposed in the quarry and could be readily exploited.

BROAD COVE (0046)
NTS 11K/06B
UTM 633100 E 5124350 N

The Broad Cove occurrence is located 5 km northeast of the Town of Inverness, Inverness County, on the shore

of the Northumberland Strait (Fig. 9-5). A steeply dipping section of interbedded gypsum, clastic and carbonate units can be found along the coast in this area. In addition two drillholes were completed in this area in 1907 by the Department (Province of Nova Scotia, 1908). Minor karst topography can be found inland from the outcrop area.



Geology after Cameron, 1948a

Figure 9-5. Location and geology of the Broad Cove occurrence area. See Figures 9-1 and 9-2 for legend and location.

Geological mapping by Cameron (1948a) indicated that this area is underlain by the undivided Windsor Group. These rocks are in fault contact with clastics of the Canso Group Mabou Formation to the east and in fault contact with clastics of the Pictou Group Broad Cove Formation to the west. Giles (personal communication) believes that the shoreline section represents the uppermost Windsor Group (E Subzone) and base of the Canso Group Watering Brook Formation equivalent (Giles and Bochner, 1982).

Although the exact collar locations of the holes drilled in 1907 are not known, the thickness of the gypsum encountered in hole 163 (24.2 m) is due to the fact that the local bedding, as seen at the shore, is steeply dipping. The gypsum seen at Broad Cove is very interesting geologically but its interbedded, steeply dipping setting plus the limited extent of Windsor Group outcrop at Broad Cove, make this occurrence one of little economic interest.

CAPTAINS BROOK (0067)

NTS 11F/14C

UTM 617900 E 5092800 N

The Captains Brook area is located approximately 45 km north of Port Hastings and 2 km southwest of Glencoe Station, Inverness County (Fig. 9-6). It consists of two small outcrops along the Brook with minor areas of lightly karsted topography adjacent to them.



Geology after Kelley, 1968a

Figure 9-6. Location and geology of the Captains Brook occurrence area. See Figures 9-1 and 9-2 for legend and location.

Geological mapping in the area by Kelley (1968a) placed these units in the Mabou Formation of the Canso Group. Although not noted by Kelley (1968a) as such these sulphates are most likely lateral equivalents of the lower most Watering Brook Formation of the Canso Group as described by Giles and Boehner (1982) in the Shubenacadie Basin. No drillhole information is available in the immediate area which might substantiate this conclusion.

This area is of no economic interest.

CHÉTICAMP (0047)

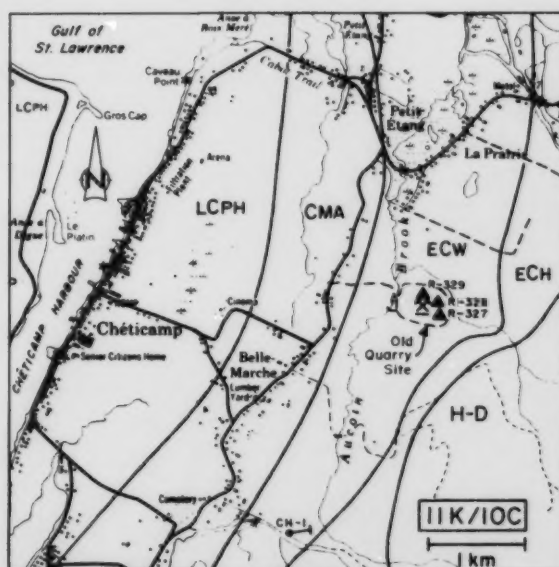
NTS 11K/10C

UTM 655500 E 5165500 N

The Chéticamp deposit is located 3.5 km east of the Village of Chéticamp, Inverness County (Fig. 9-7). Gypsum was produced intermittently at quarries in the Chéticamp area between 1900 and 1940. A calcining

plant was also operated at Chéticamp for part of this period with finished plaster products sent to Upper Canada.

Ownership of gypsum leases changed five times during the active life of operations at Chéticamp. The Great Northern Mining and Railway Company held the properties from 1906-1915 at which point they ceased production. The leases were acquired in 1923 by the International Gypsum Company then gained the following year by the P. M. O'Neil Gypsum Company. In 1925 operations halted again only to restart in 1927 under the name of Atlantic Gypsum Products. The National Gypsum Company took over in 1936 and carried on until the quarries were finally closed in 1940 (King, 1985).



Geology after Cameron, 1948b; MacLaren, 1956a

Figure 9-7. Location and geology of the Chéticamp occurrence area. See Figures 9-1 and 9-2 for legend and location.

Although records for the early history of production are poor, a total of 1 324 943 t of gypsum were produced at Chéticamp over the 19 years between 1912 and 1940. Average annual production was 69 736 t, however this varies from a low of 371 t in 1923 to a high of 203 307 t in 1930. According to King (1985) gypsum leases at Chéticamp were renewable after only five years and it is unlikely that any gypsum companies presently hold leases in the area.

The Chéticamp deposit (also known as Belle Marche) lies on the eastern side of a northerly trending Carboniferous syncline that dips westward under the

waters of the Gulf of St. Lawrence. These Carboniferous rocks are bound on the east by Horton Group clastics and Hadrynian granitoid rocks.

Gypsum at Chéticamp was from the Windsor Group which is underlain to the east by clastics of the Horton Group and overlain to the west by clastics of the Canso Group (MacLaren, 1956a). Due to the steeply dipping strata in this area (50-70°W) the Windsor only subcrops along a strip 500-1500 m wide.

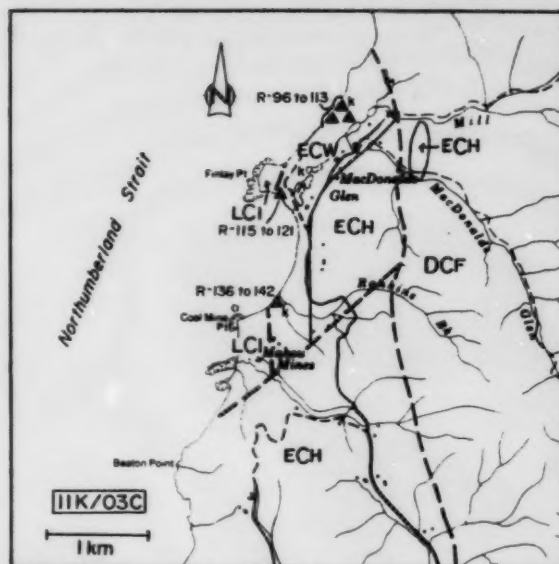
Getty Mines Ltd. carried out extensive geological mapping in the area in 1974 as part of its base metals exploration program (Comeau, 1974c). They also drilled one inclined diamond-drill hole south of the old quarry area (CH-1) to a depth of 328.57 m. No detailed stratigraphic interpretation has been attempted in the area, however the units present are believed to belong to Cycle 2 (B Subzone) of the Windsor Group.

The drillhole encountered only 2.74 m of overburden then went through 54.86 m of interbedded shales and sandstones before encountering the gypsiferous section. A total of 130.36 m out of 262.89 m cored in the lower part of CH-1 was gypsum. Brecciated shales make up most of the interbedded material which included some minor carbonates. The hole was stopped in basal anhydrite before it reached the underlying Horton rocks.

Steeply dipping strata with significant proportions of interbedded materials would make mining of gypsum at Chéticamp a costly proposition. Further investigation of the area may turn up thicker units of hydrated basal anhydrite with greater development potential. The area currently has little potential for commercial development.

FINLAY POINT (0017)
NTS 11K/03C
UTM 619400 E 5110800 N

The Finlay Point occurrence area is located 9 km north-northwest of Mabou, Inverness County (Fig. 9-8). Extensive outcrops of nodular gypsum can be seen along the shore from Finlay Point north for 1000 m and a second area 1100 m south just north of Coal Mine Point. The gypsum appears to belong to the Lower Windsor and is in fault contact with younger clastics to the west. Regional mapping by Norman (1935) indicated that the Windsor units are underlain by older, Horton Group clastics to the south and east and in fault contact with the Devono-Carboniferous Fisset Brook Formation to the northeast.



Geology after Norman, 1935; Keppie, 1979

Figure 9-8. Location and geology of the Finlay Point occurrence area. See Figures 9-1 and 9-2 for legend and location.

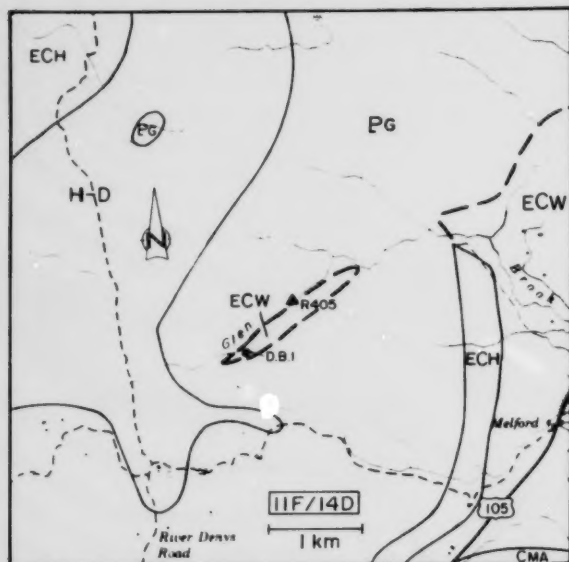
A topographic high, which is karsted, extends east-northeast away from the exposures on the shore north of Finlay Point for >600 m and may be underlain entirely by gypsum. An independent engineering study, undertaken in 1962 (Domtar Gypsum, confidential company report) used seismic information on the area gathered by the Nova Scotia Research Foundation. The study suggested that 36.1 Mt of gypsum might be present at Finlay Point. Only one-third of this material or approximately 12 Mt was above sea level.

This area warrants some additional work in the form of diamond drilling. One major drawback seen would be the shallow water found along this shore which would allow only small vessels to be used for transport.

GLEN BROOK (0091)
NTS 11F/14D
UTM 632100 E 5082200 N

The Glen Brook (previously known as Diogenes Brook) occurrence area is located 30 km north-northeast of the Town of Port Hawkesbury, Inverness County (Fig. 9-9). It is accessible by bush road up the valley of Glen Brook from the Trans-Canada Highway 105 at Melford.

Kelley (1968a) described the geology of the immediate area as a fault-bound block of Windsor Group surrounded by Precambrian George River Group



Geology modified after Kelley, 1968a

Figure 9-9. Location and geology of the Glen Brook occurrence area. See Figures 9-1 and 9-2 for legend and location.

metamorphic rocks. The occurrence consists of one or more rounded, fine- to medium-grained gypsum outcrops. No stratigraphic interpretation has ever been undertaken to determine what portion of the Windsor Group is present at Glen Brook. Work carried out by Dickie (1987) included one drillhole D.B. 1 which drilled through 119.5 m of Cretaceous material which is believed to have infilled the previously eroded Windsor Group sedimentary rocks. The hole was only drilled to 121 m and encountered 1.5 m of weathered breccia with sedimentary rock fragments thought to be Windsor Group.

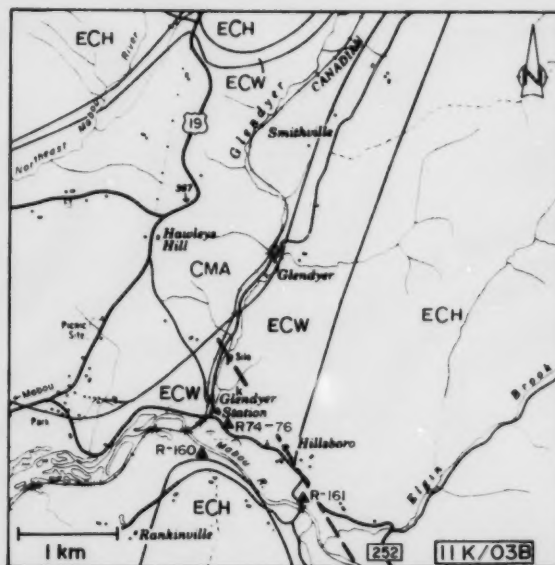
Although the area is of geological interest and a possible silica sand source (MacDonald, 1988) it is of no economic interest for gypsum or anhydrite.

GLENDYER STATION (0013)
NTS 11K/03B
UTM 627200 E 5103500 N

The Glendyer Station occurrence is located 3 km east of Mabou, Inverness County (Fig. 9-10). Outcrops of gypsum of varying purity can be found both north and south of the Mabou River in this area. These exposures, as well as an area of karst topography which extends north of Route 252 (discontinuous over 1200 m), comprise all of the information available in the area.

Geological mapping by Norman (1935) indicated the immediate area to be underlain by a north-northeastward striking section of undivided Windsor Group rocks. These are underlain to the east by Horton Group clastics and overlain to the west by clastics of the Mabou Formation of the Canso Group. The apparent thickness and purity of the gypsum seen at this locale would indicate that these units belong to the lower part of the Windsor Group, either Cycle 1 (A Subzone) or Cycle 2 (B Subzone).

Although of geological interest this occurrence's remote location and apparent lack of lateral extent make it of little economic interest.



Geology after Norman, 1935

Figure 9-10. Location and geology of the Glendyer Station occurrence area. See Figures 9-1 and 9-2 for legend and location.

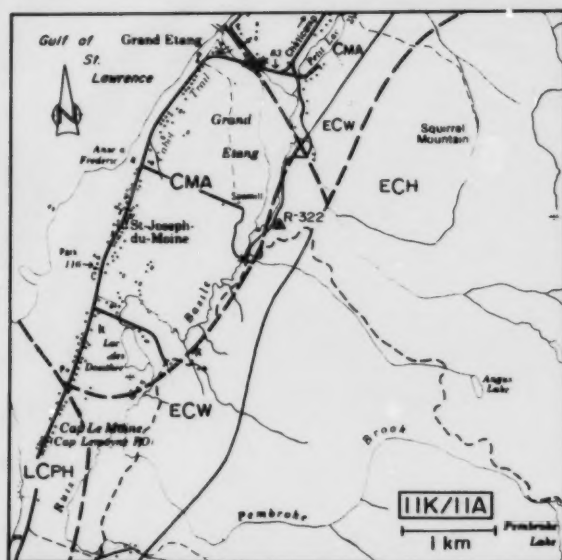
GRAND ÉTANG (0071)
NTS 11K/11A
UTM 650400 E 5154800 N

Grand Étang is located 10 km south of Chéticamp, Inverness County (Fig. 9-11). The occurrence consists of a small block of light grey, fine grained gypsum found at the southeastern corner of the pond, Grand Étang.

The area was mapped by Cameron (1948b) as part of the Chéticamp map area. He interpreted the geology as a set of offset fault blocks of thin Windsor Group sedimentary rocks between underlying Horton Group

clastics to the east and overlying Canso Group clastics to the west. The sulphate units probably belong to either the Cycle 1 or 2 (A or B Subzone) of the Windsor Group, however no detailed stratigraphic interpretation of the area has been attempted to date.

Although the occurrence is situated along strike from the previously mined gypsiferous areas at Chéticamp, it is of more geological than economic interest. Available gypsum would be limited due to the limited extent of area underlain by Windsor Group units here which hinder its development potential.



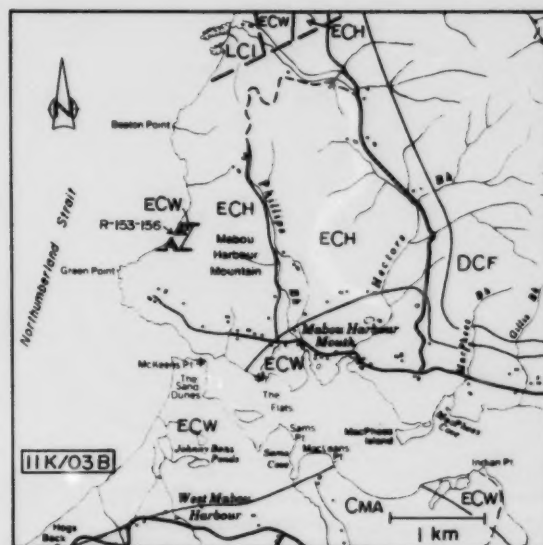
Geology modified after Cameron (1948b)

Figure 9-11. Location and geology of the Grand Étang occurrence area. See Figures 9-1 and 9-2 for legend and location.

GREEN POINT (0021)
NTS 11K/03B
UTM 617700 E 5106000 N

The Green Point occurrence is located along the shore between Green Point and Beaton Point 7 km northwest of the Village of Mabou, Inverness County (Fig. 9-12). Norman (1935) mapped this area as a fault-bound block of Lower Windsor Group surrounded by Horton Group clastics.

Consisting of three small contorted gypsum outcrops which are slowly disintegrating into the Northumberland Strait, this occurrence is of more scenic interest than economic.

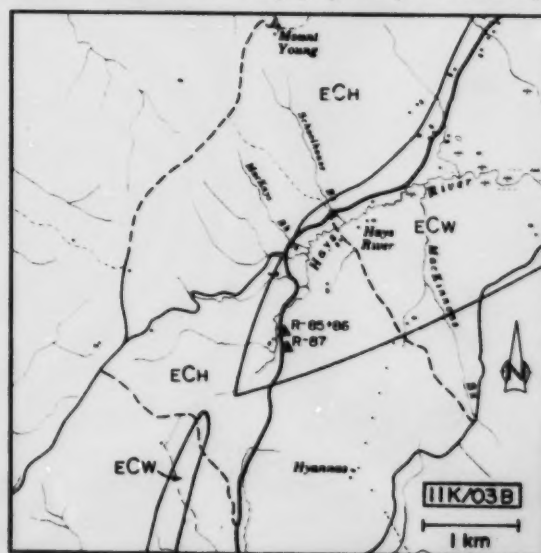


Geology after Norman, 1935

Figure 9-12. Location and geology of the Green Point occurrence area. See Figures 9-1 and 9-2 for legend and location.

HAYS RIVER (0015)
NTS 11K/03B
UTM 634000 E 5105900 N

The Hays River occurrence is located 15 km northeast of Mabou, Inverness County (Fig. 9-13). Several expo-



Geology after Norman, 1935

Figure 9-13. Location and geology of the Hays River occurrence area. See Figures 9-1 and 9-2 for legend and location.

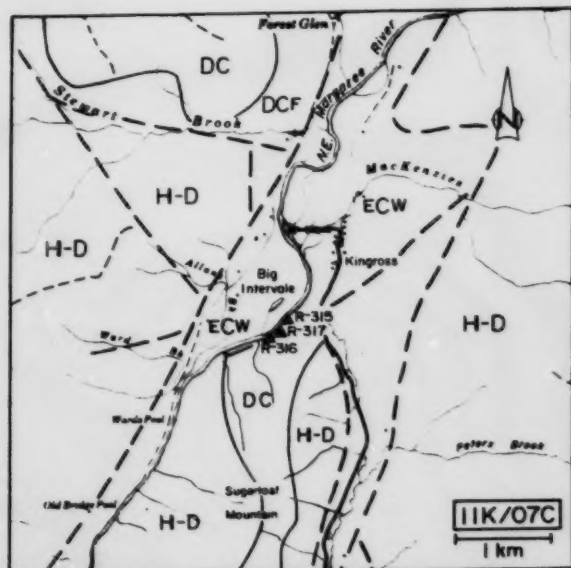
tures of gypsum of varying purity can be found in this area. Norman (1935) mapped this area as being underlain by Lower Windsor Group rocks, lying in a north-easterly plunging syncline which is underlain by clastics of the Horton Group.

Limited outcrop area and the remote location of this occurrence make it of geological interest only.

KINGROSS (0069)
NTS 11K/07C
UTM 659200 E 5144700 N

Kingross is located 10 km north of the Village of Margaree Valley, Inverness County (Fig. 9-14). The occurrence consists of several exposures of light grey, hard, fine- to medium-grained gypsum interbedded with light brown limestone, redbeds and black, brecciated limestone. Kelley (1960) mapped these units as undivided Windsor Group in fault contact with older igneous and metamorphic rocks to the south. Recent work by Barr et al. (1987) has updated the mapping of these older rocks. The outcrops are found along the eastern bank of the Northeast Margaree River approximately 1.0-1.2 km downstream below the highway bridge connecting Kingross and Big Intervale.

These outcrops are of geological interest, but have little or no economic value due to their remote location and apparent lack of extent.

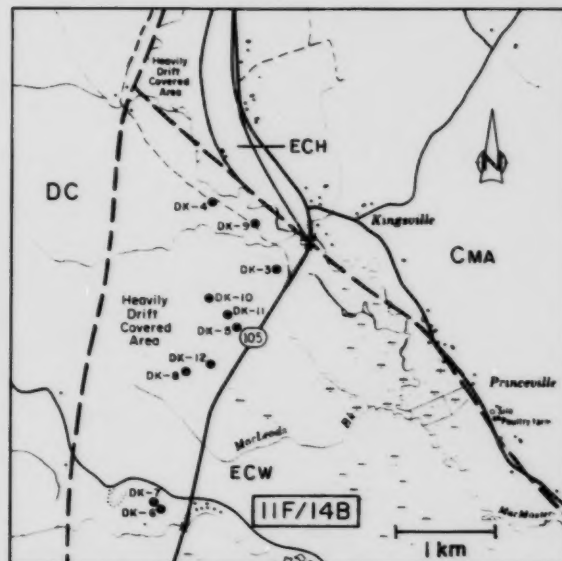


Geology modified after Kelley, 1960; Barr et al., 1987

Figure 9-14. Location and geology of the Kingross occurrence area. See Figures 9-1 and 9-2 for legend and location.

KINGSVILLE (0040)
NTS 11F/14B
UTM 629500 E 5070000 N

The Kingsville occurrence area is located 15 km north-east of Port Hawkesbury, Inverness County (Fig. 9-15). No outcrops or karst topography were found in this area, however between 1968 (René and Rowbottom, 1968) and 1970 (René, 1970) Domtar Chemicals Limited drilled 10 holes (DK-3 to DK-12) in this area as part of a salt exploration program.



Geology after Kelley, 1968a; Keppie, 1979

Figure 9-15. Location and geology of the Kingsville occurrence area. See Figures 9-1 and 9-2 for legend and location.

Regional geological mapping by Kelley (1968a) showed this area as drift covered with no geological interpretation. Keppie (1979) indicated that the area is underlain by undivided Windsor Group rocks which are in fault contact with Devono-Carboniferous basement to the west and in fault contact with clastics of the Canso Group to the northeast. Domtar's drilling established that a large salt deposit underlies this area at depth (Boehner, 1986). Typical of all the deformed saline Windsor Group strata in the area, salt has been removed by groundwater dissolution to a depth of 200-300 m.

Seven of Domtar's drillholes were triconed for the top +100 m making it difficult to determine the near surface geology. Holes DK-10, -11 and -12 all encountered in excess of 30 m of overburden. These same three holes encountered good gypsum intervals some of which Domtar analyzed (C. René, personal communica-

tion). The best interval was in DK-10 where 15.5 m of gypsum grading 87.7% was found from 48.8-64.3 m.

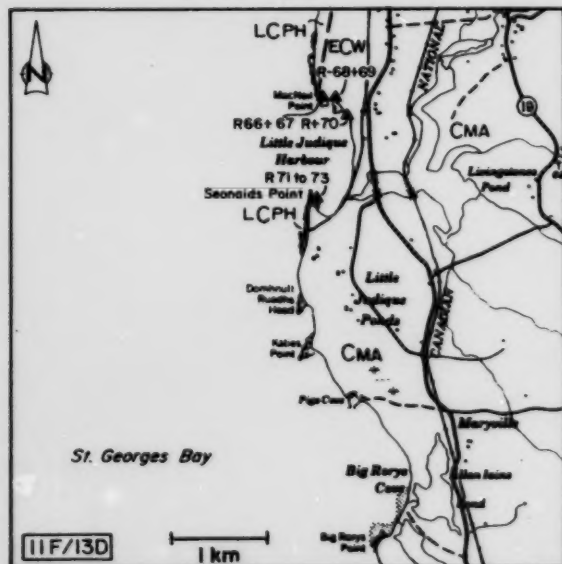
Gypsum found at Kingsville is covered by thick overburden. The presence of an underlying salt mass suggests that these upper units belong to the Upper Windsor, Cycles 3-5 (C-E Subzones) and are thus unlikely to contain significant amounts of gypsum or anhydrite. Further work for gypsum or anhydrite at Kingsville cannot be justified.

LITTLE JUDIQUE HARBOUR (0012)

NTS 11F/13D

UTM 613900 E 5091300 N

Little Judique Harbour is located 6.5 km south of Port Hood, Inverness County (Fig. 9-16). The occurrence consists of a number of outcrops of gypsum exposed at MacNeil Point on the northern side of the Harbour and Seonaid's Point on the southern side.



Geology modified after Kappie, 1979

Figure 9-16. Location and geology of the Little Judique Harbour occurrence area. See Figures 9-1 and 9-2 for legend and location.

Regional mapping by Norman (1935) indicated that the gypsum units belonged to the Upper Windsor Group. These were overlain to the east by clastics of the Mabou Formation of the Canso Group and in fault contact with clastics of the Port Hood Formation of the younger Riversdale Group to the west. Later work on the section at MacNeil Point (Ragged Point) by Stacy (1953) identified a carbonate interbed as the E₁ limestone. Bochner and Giles (personal communication)

place the calcium sulphate horizons in the Watering Brook Formation of the Canso Group.

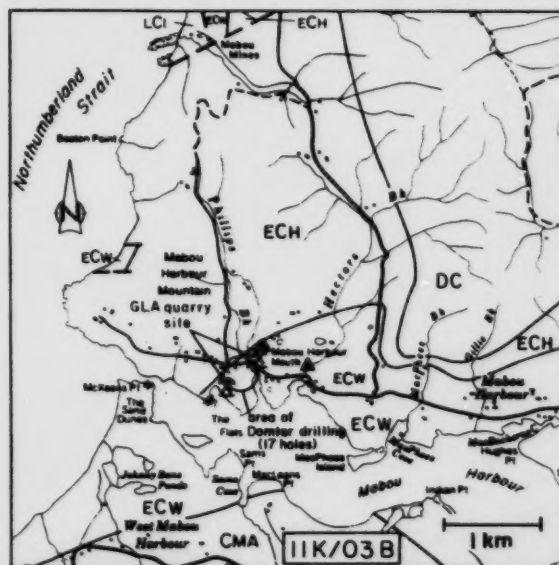
This occurrence is of geological interest only.

MABOU HARBOUR MOUTH (0044)

NTS 11K/03B

UTM 619000 E 5105000 N

The Mabou Harbour Mouth area is located 5 km west of Mabou, Inverness County (Fig. 9-17). Gypsum was produced from a small quarry intermittently from 1891-1940. Last operated by the Nova Scotia Coal and Gypsum Company, a subsidiary of Gypsum, Lime and Alabastine Canada Limited, the property now belongs to Domtar Gypsum (Domtar Gypsum, confidential company report).



Geology modified after Norman, 1935

Figure 9-17. Location and geology of the Mabou Harbour Mouth occurrence area. See Figures 9-1 and 9-2 for legend and location.

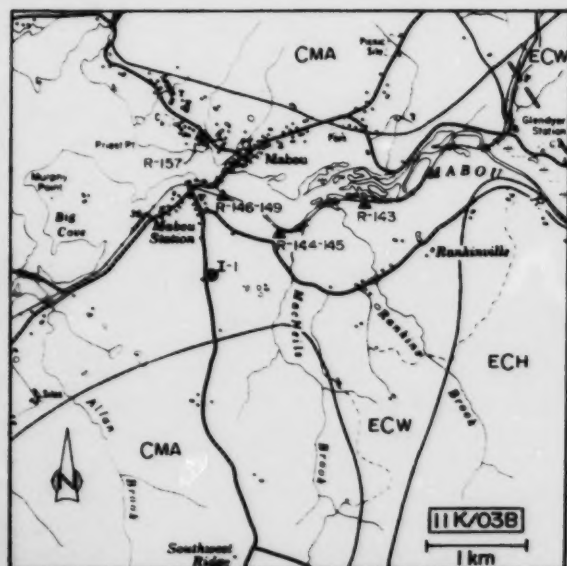
In 1960 Domtar drilled 17 drillholes on two adjoining areas of its property to evaluate the potential for future development of this deposit (Domtar Gypsum, confidential company report). One drillhole located just north of the old quarry intersected 19.8 m of gypsum, however it was the only hole which penetrated >9.1 m of gypsum. The area was determined to be on the northern side of a syncline which runs roughly northeast-southwest and plunges to the southwest (Norman, 1935). Clastic sedimentary rocks of the underlying Horton Group outcrop just to the north and northwest of the sulphate bearing areas.

Domtar determined that hydration was locally controlled by the porosity of adjoining beds, in this case the underlying Horton Group and infilled solution trench which often occurs at the Horton-Windsor contact. Also they believed that groundwater runoff patterns dictated depth of hydration of the anhydrite (Domtar Gypsum, confidential company report). A total of only 1.86 Mt of gypsum reserves was estimated for the quarry area and immediate vicinity. Reserves below sea level were not calculated because the amount of gypsum available would not warrant the extra cost of pumping water.

Domtar still holds gypsum leases (not shown on map) over much of the area around the quarry. The volume of gypsum available, however, would probably prohibit any future development.

MABOU STATION (0020)
NTS 11K/03B
UTM 624400 E 5102600 N

The Mabou Station occurrence area is located immediately south of the Mabou River, near Mabou Station, Inverness County (Fig. 9-18). Numerous small gypsum outcrops can be found along the River bank in this area. These consist of light brown to white, nodular gypsum with minor intermixed dark brown carbonate. Some limestone interbeds can be seen along the River. One drillhole was completed in this area by Imperial Oil Ltd.



Geology after Norman, 1935

Figure 9-18. Location and geology of the Mabou Station occurrence area. See Figures 9-1 and 9-2 for legend and location.

in 1959 as part of an oil exploration program (Cote, 1958). A total depth of 155 m was attained, the lower 52 m of which consisted of interbedded gypsum and anhydrite with abundant caves.

Regional geological mapping by Norman (1935) indicated that this area is underlain by undivided Windsor Group units. These are underlain by Horton Group clastics to the east and overlain by younger clastics of the Canso Group Mabou Formation to the south and west. No detailed stratigraphic interpretation of the Windsor Group has ever been undertaken in this area.

Although numerous outcrops of gypsum are found along the River in this area, no amount of karst topography can be seen which might indicate more extensive subcropping of gypsum. This occurrence is primarily of geological interest.

MACINTYRE LAKE (0016)
NTS 11F/11C
UTM 634000 E 5058000 N

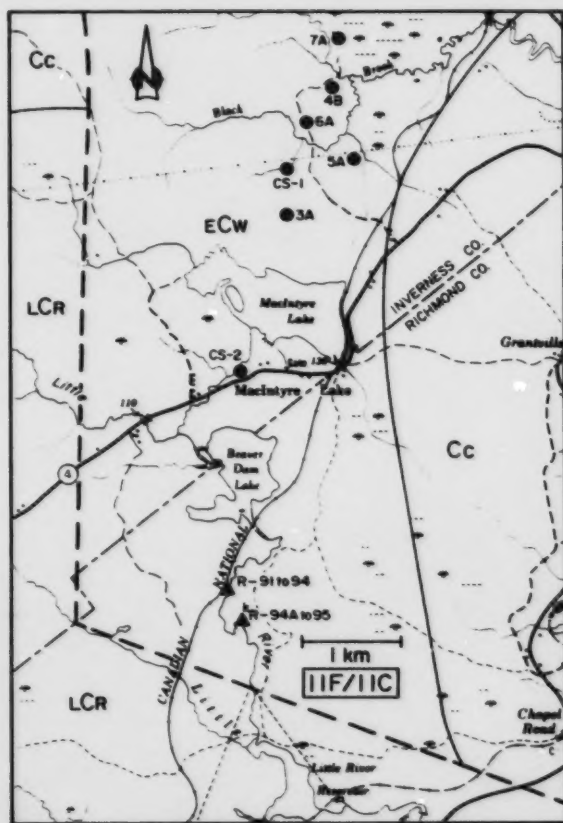
The MacIntyre Lake occurrence is located 6 km north-east of Port Hawkesbury, Inverness County (Fig. 9-19). The area straddles the county line between Inverness and Richmond Counties. A number of small outcrops of white to light grey gypsum with varying amounts of intermixed carbonate can be found along the Little River south of Beaver Dam Lake. An area of karst topography can also be seen 1 km south of Beaver Dam Lake. A total of seven drillholes were completed in the northern portion of the area between 1972 and 1978 by Northern Canadian Oil and Murphy Oil Co. Ltd. (Hale, 1972; 1974) and Home Oil Co. Ltd. (Home Oil Co. Ltd., 1978) investigating oil storage caverns in salt bodies.

Geological mapping in this area by Ferguson and Weeks (1950) indicated that much of this area is underlain by undivided Windsor Group rocks trending northerly and dipping to the east under clastic units of the Canso Group. Clastics of the Riversdale Group are in fault contact with the Windsor to the west and south.

The seven drillholes completed in this area by Northern Canadian Oil and Murphy Oil (CS-1 and CS-2) and Home Oil (3A, 4B, 5A, 6A and 7A) were the subject of a study by Giles (1981b). He found that the area is underlain by interbedded halite, sulphate evaporites, carbonates and clastics of both the 'Upper' and 'Lower' Windsor Group. Complex stratigraphy of the area reflects low angle faulting and folding of the original horizons. The presence of interbeds of anhydrite and carbonates in all of the salt horizons observed

in this area suggests that the drilling never reached the thicker salts usually found in the Cycle 1 (A Subzone).

The abundance of salt interbeds, as well as the structural complexity of this area, both detract from the MacIntyre Lake area's economic potential. The fact that much of the area lies within the boundary of the water supply area for Port Hawkesbury would also hinder additional investigation of the areas of karst topography south of Beaver Dam Lake. The area's proximity to deep water shipping at Port Hawkesbury makes it worthy of additional investigation in the vicinity of those outcrops and karst areas found in the southern portion of this area.



Geology after Ferguson and Weeks, 1950

Figure 9-19. Location and geology of the MacIntyre Lake occurrence area. See Figures 9-1 and 9-2 for legend and location.

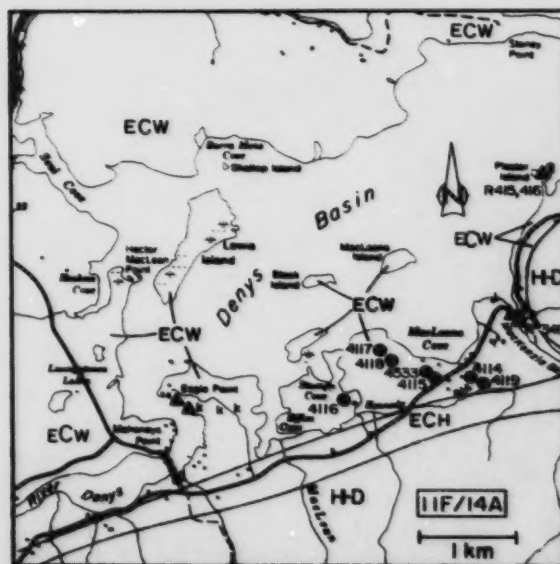
MACLEANS COVE (0034)
NTS 11F/14A
UTM 650650 E 5080400 N

The MacLeans Cove occurrence area is located 10 km east-northeast of River Denys, Inverness County (Fig.

9-20). A series of six short drillholes were completed by the Department of Mines in 1965 (Nova Scotia Department of Mines, 1965b) as part of a limestone investigation. Another hole (4533) was drilled by the Department in 1968 (Province of Nova Scotia, 1969a). Several exposures can be found in this area; large grey, gypsum outcrops can be seen at Eagle Point and Plaster Island. A small outcrop can be found beside a secondary road where it crosses MacKenzie Brook. Karst topography is evident in the area of Eagle Point and Plaster Island.

Regional geological mapping by Kelley (1968a), showed this area as being underlain by units of the Windsor Group which are underlain by Horton Group clastics to the south. Nova Scotia Department of Mines drillholes (1965b) were believed to have encountered a Cycle 2 (B Subzone) carbonate. The thickness of adjacent gypsum and anhydrite units suggests that the carbonate is near the base of the Cycle 2 (B Subzone) and the local geology is either moderately folded or faulted.

Although interesting exposures and karst are present in the MacLeans Cove area, the potential resource is narrow and constrained by the basement to the south and the waters of Denys Basin to the north. This would preclude any possible development.

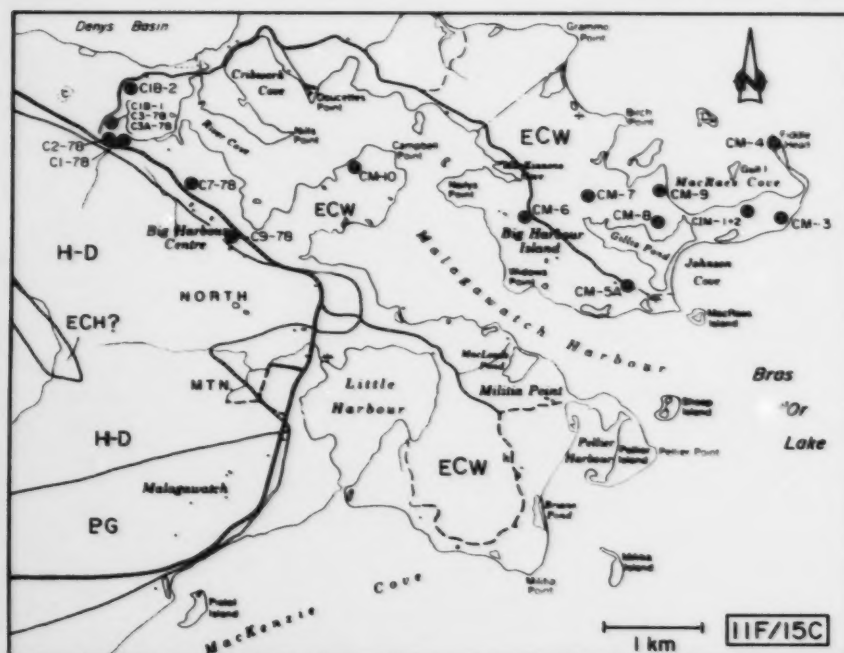


Geology after Kelley, 1968a; Kappin, 1979

Figure 9-20. Location and geology of the MacLeans Cove occurrence area. See Figures 9-1 and 9-2 for legend and location.

MALAGAWATCH (0035)
 NTS 11F/15C
 UTM 656000 E 5081000 N

The Malagawatch occurrence area is located 15 km east-northeast of River Denys, Inverness County (Fig. 9-21). Although some light karst topography is evident within this area most of the information available comes from drilling carried out by Chevron Standard Limited between 1978 and 1981 (Dekker, 1982).



Geology after Weeks, 1955; Kelley 1968a; Keppie, 1979

Figure 9-21. Location and geology of the Malagawatch occurrence area. See Figures 9-1 and 9-2 for legend and location.

Regional geological mapping by Weeks (1955) and Kelley (1968a) indicated that this area is underlain by undivided Windsor Group rocks. These are underlain to the southwest and west by granitic basement rocks. The Windsor Basin deepens to the northeast and east under the waters of the Bras d'Or Lake.

A total of 18 drillholes have been completed in the Malagawatch area. Fourteen of these were diamond-drill holes and the rest were petroleum exploration wells which produced only chip samples (Boehner, 1986). In 1978 Chevron Standard drilled six diamond-drill holes (C1-78 to C3-78, C3A-78, C7-78, C9-78) while exploring for base metals and encountered light crude oil (Dekker, 1982). In 1979 Chevron, in conjunction with Irving Oil Company Limited, drilled four oil wells (CIB-1, CIB-2,

CIM-1, CIM-2) which encountered significant potash horizons (Dekker, 1982). Finally in 1980-81 Chevron completed eight deep diamond-drill holes (CM-3 to CM-10) searching for potash (Dekker, 1982).

All of these holes intersected evaporites, carbonates and clastic sedimentary rocks of the Windsor Group, and Dekker (1982) stated that all major cycles of the Windsor had been encountered. Holes drilled further out into the Carboniferous basin encountered thick sections of saline evaporites. The strata representing Cycles

2-5 (B-E Subzones) display complex folding and faulting with overturned sections and stratigraphic repetitions. Holes located nearest the basin margin penetrated Cycle 1 (A Subzone) evaporites and went into Devonian-Carboniferous basement intrusives which outcrop in the highlands to the west of the area. The best gypsum intersection encountered was in hole C7-78 where 18.7 m (61.25 ft) of gypsum in the basal anhydrite of Cycle 1 (A Subzone) underlies 6.7 m (22.0 ft) of overburden. Most of the sulphates in this area, except where seen at surface, are anhydrite of which there are vast resources.

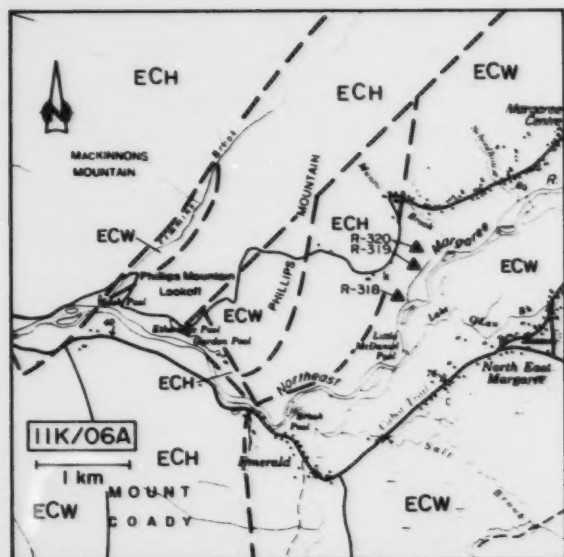
Unfortunately the most prospective areas for deep hydration, along the basal Windsor contact, are confined between the basement to the west and the waters of the

basin to the east. It is unlikely that any substantial development could take place in this area due to this limitation.

MARGAREE CENTRE (0070)
 NTS 11K/06A
 UTM 652300 E 5133000 N

The Margaree Centre occurrence is located 2 km southwest of the Village of Margaree Centre, Inverness County (Fig. 9-22). The occurrence consists of a highly visible discontinuous cliff of gypsum approximately 300 m in length which lies on the northwestern wall of the Northeast Margaree River valley. These exposures are accompanied by heavy to moderate karst topography and smaller outcrops to the northwest.

Mapped by Cameron (1948a) as undivided Windsor Group; this occurrence probably represents units of the basal sulphate of the Cycle 1 (A Subzone). A distinct solution trench, common along the Horton-Windsor contact can be found approximately 100 m northwest of the cliffs. This feature runs 010-020° and is indicative of the local strike of this contact. The trench is locally >20 m deep.



Geology after Cameron, 1948a

Figure 9-22. Location and geology of the Margaree Centre occurrence area. See Figures 9-1 and 9-2 for legend and location.

Although no drillhole information is available in the area, surface indications suggest that there could be in excess of 1 Mt of gypsum in the immediate area. This would not be sufficient to warrant large scale development, however it might be useful at some future time as a local source of agricultural gypsum.

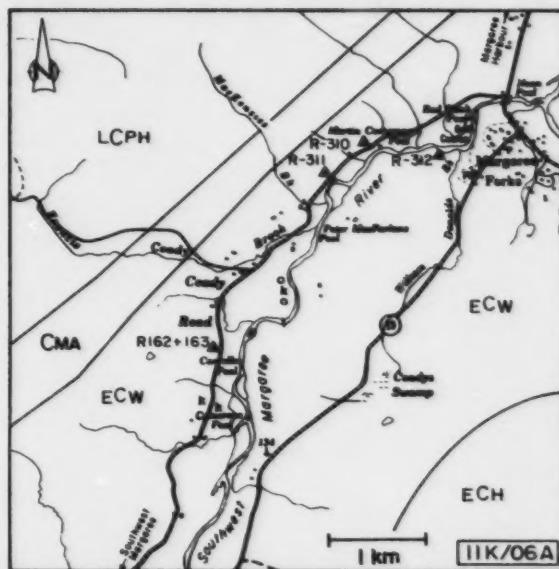
MARGAREE FORKS (0023)

NTS 11K/06A

UTM 643400 E 5130400 N

The Margaree Forks area is located 11 km south of Margaree Harbour along the Southwest Margaree River (Fig. 9-23). Cameron (1948a) noted a number of gypsum outcrops and sinkholes in an area from Margaree Forks to South West Margaree which he mapped as undivided Windsor Group. These are underlain by Horton Group clastics to the southwest, south and east and are overlain by clastics of the Mabou Formation to the northwest.

Karst topography is generally light and not extensive and gypsum outcroppings are usually small. Additional investigation might identify more extensive gypsiferous areas, however the distance of the area from shipping facilities makes it economically unattractive.



Geology after Cameron, 1948a

Figure 9-23. Location and geology of the Margaree Forks occurrence area. See Figures 9-1 and 9-2 for legend and location.

MARGAREE HARBOUR (0045)

NTS 11K/06D

UTM 646000 E 5142500 N

The Margaree Harbour occurrence area is located 22 km south-southeast of Cheticamp, Inverness County, along the Cabot Trail (Fig. 9-24). One exposure of white gypsum overlain by black limestone can be found along the shore at Belle Côte in this area. Other information comes from five drillholes completed by Eastern Gulf Oil Company in 1927 (Province of Nova Scotia, 1928a).

Regional geological mapping by Cameron (1948a) indicated that this area is underlain by a northerly trending sequence of undivided Windsor Group. These units are underlain to the east by clastics of the Horton Group and overlain to the west by clastics of the Canso Group Mabou Formation.

All five drillholes were located in the Valley of the Margaree River and all encountered thick overburden,

generally >30 m. Detailed logs or core from these drillholes are not available. No exact locations are known for any of these drillholes, consequently stratigraphic interpretation is impossible. Substantial gypsum thicknesses with mud and carbonate interbeds were described in the log of hole 532 (Province of Nova Scotia, 1928a), however additional information is lacking which would allow further detailed assessment of this area. In addition, the location of this area, in the Valley of the Margaree River, would preclude any possible development. Therefore the Margaree Harbour occurrence is of geological interest only.



Geology after Cameron, 1948a; Keppie, 1979

Figure 9-24. Location and geology of the Margaree Harbour occurrence area. See Figures 9-1 and 9-2 for legend and location.

MELFORD (0037)
NTS 11F/14B
UTM 635000 E 5080000 N

The Melford occurrence area is located 29 km northeast of Port Hawkesbury, Inverness County (Fig. 9-25), just south of the Upper River Denys occurrence area (0036). Available information on the area comes from logs of government drills which completed a series of six holes for Mr. G. Logan in 1956 (Province of Nova Scotia, 1957d) and several small rounded outcrops of medium grained gypsum containing minor interstitial and interbedded carbonates and siltstones located on the southern side of a bush road which cuts through the area.

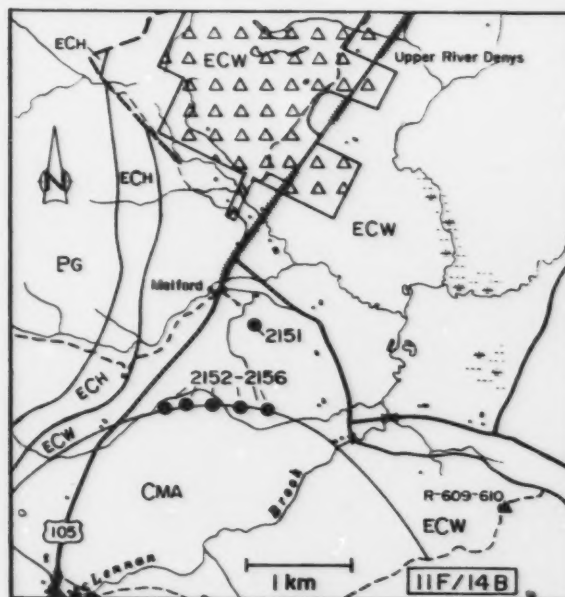
Kelley (1968a) mapped this area as being underlain by undivided Windsor Group sedimentary rocks in a

basin which deepens to the southeast. These units are underlain by clastics of the Canso Group to the south.

Five of Logan's holes were drilled along the Windsor-Canso contact and the sixth was completed 800 m to the north. All drillholes encountered gypsum, anhydrite, carbonates and clays of the Windsor Group. The high portions of gypsum described in drillers logs would indicate that they belong to the top of Cycle 1 (A Subzone) or base of Cycle 2 (B Subzone). Correlation between these holes, located only 200 m apart, is apparently impossible because the drillholes are shallow depth and there appears to be structural deformation or dissolution of parts of the section.

Overburden thickness is generally <12.2 m. Gypsum is often interbedded with clay and limestones and contains varying amounts of these materials interstitially. The best section of gypsum encountered was in hole 2151 in which 44.3 m of 51.2 m were described as white gypsum with grey limestone and red clay interbeds (Province of Nova Scotia, 1957d). This was overlain by only 10.4 m of overburden.

This area has been the subject of additional drilling carried out by Georgia-Pacific Corporation over the years (J. Graham, personal communication). This area warrants further work because it is located near the Trans-Canada Highway and within 30 km of Port Hawkesbury.



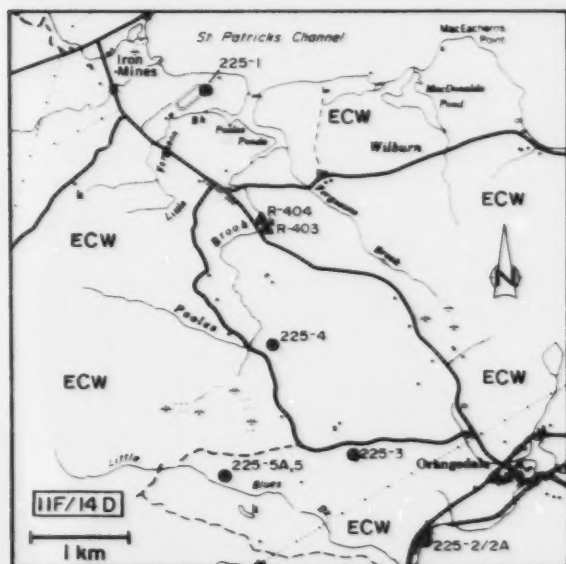
Geology after Kelley, 1968a

△ Georgia-Pacific Corporation (fee simple)

Figure 9-25. Location and geology of the Melford occurrence area. See Figures 9-1 and 9-2 for legend and location.

ORANGEDALE (0033)
 NTS 11F/14D
 UTM 645000 E 5085000 N

The Orangedale occurrence area is located 8 km south of Whycocomagh, Inverness County (Fig. 9-26). Although several small areas of light karst topography and a few small outcrops of gypsum can be found in the area, most of the information available is from drillhole data. This drilling was carried out by Bestwall Gypsum (Georgia-Pacific Corporation, unpublished company reports) in the late 1950s and by Noranda Exploration Company Ltd. between 1978 (Leahey, 1979) and 1981 (Cooper, 1980; 1982) as part of a regional potash exploration program.



Geology after Kelley, 1968a

Figure 9-26. Location and geology of the Orangedale occurrence area. See Figures 9-1 and 9-2 for legend and location.

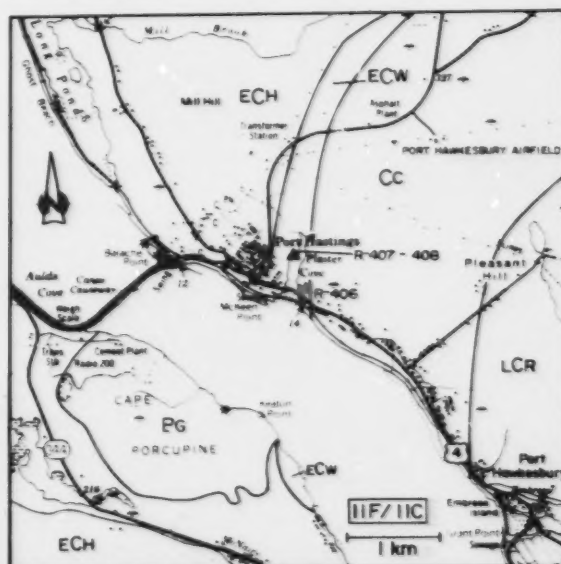
Regional geological mapping by Kelley (1968a) indicated that this area is underlain by undivided Windsor Group rocks. Bestwall's shallow drillholes encountered interbedded gypsum, carbonates and clastics apparently from Cycle 2 (B Subzone) or above. Cooper (1982) indicated that this area is structurally complex. Some of Noranda's drillholes encountered upright sections while others drilled through sections that were completely overturned. The greatest depth drilled was in hole 225-5A which was stopped at 1078.1 m in what was believed to be Cycle 2 (B Subzone) (Cooper, 1982).

All holes drilled by Noranda contained varying amounts of gypsum and anhydrite, however the most interesting intersection occurred in 225-5A. Although chip samples were the only lithological record from the upper section of the drillhole they indicate a total of 79.2 m of gypsum overlain by 21.3 m of interbedded gypsum, mudstone and limestone. This in turn was covered by 3 m of overburden. Substantial amounts of anhydrite occurred at depth in all of Noranda's drillholes.

The structurally disturbed nature of this portion of the Windsor Group rocks found in the Orangedale area does allow much deeper hydration of anhydrite, however it also makes it much more difficult to find substantial volumes of minable gypsum. This area would require a substantial drilling program to delineate reserves of gypsum. The first area to drill would be in the vicinity of 225-5A.

PORT HASTINGS (0092)
 NTS 11F/11C
 UTM 624800 E 5055900 N

The occurrence at Port Hastings is located along the shore of Plaster Cove and is visible from Route 4 between Port Hastings and Port Hawkesbury, Inverness County (Fig. 9-27).



Geology after Ferguson and Weeks, 1950

Figure 9-27. Location and geology of the Port Hastings occurrence area. See Figures 9-1 and 9-2 for legend and location.

The regional geology, as mapped by Ferguson and Weeks (1950), indicated the area is underlain by Windsor Group rocks which are underlain by Horton Group clastics to the west and overlain by Canso Group clastics to the east. Although stratigraphic interpretation has not yet been undertaken the local geology is believed to be somewhat structurally complex with Macumber Formation at the base of the Windsor Group in close proximity to Cycle 2 and Canso Group strata near Plaster Cove. The entire Windsor Group is represented by a section only 200-300 m in width.

The occurrence consists of several outcrops along Plaster Cove, the more prominent of which consist mainly of coarse, crystalline anhydrite which is in part hydrated to high purity medium- to coarse-grained gypsum.

Although substantial volumes of high purity anhydrite may be present at this locale the proximity to Port Hastings would probably prevent any development. A greater understanding of the geology of the area may lead to the discovery of exploitable resources at some point along strike.

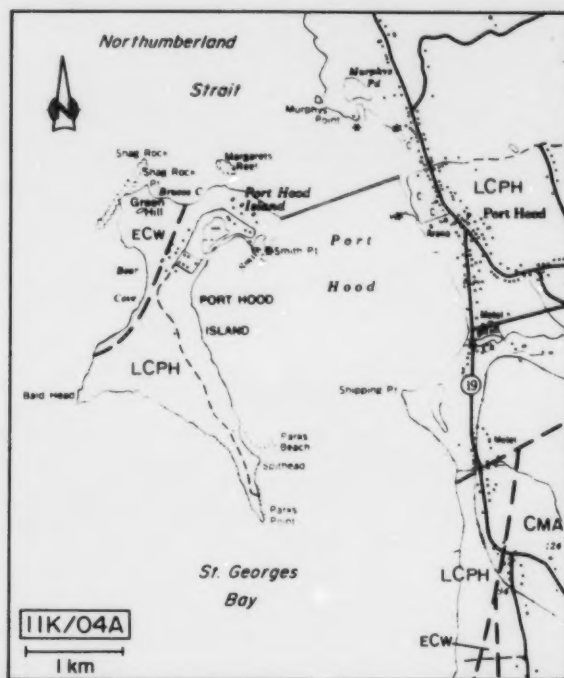
PORT HOOD ISLAND (0090)

NTS 11K/04A

UTM 610500 E 5096400 N

The Port Hood Island occurrence is located on the northwestern portion of Port Hood Island, Inverness County (Fig. 9-28) (not visited by author, therefore not marked on map). A well exposed Upper Windsor Group section containing gypsum interbeds, found along the western shore of the Island, south of Shag Rock Point, has been the subject of detailed examination by numerous authors over the years. Regional geological mapping by Norman (1935) indicated that the occurrence area is underlain by units of the Upper and Lower Windsor Group. These are in fault contact with younger clastics of the Riversdale Group, Port Hood Formation to the east.

Probably the most detailed description of the section was given by Stacy (1953). Giles (1982a) correlated this section, which Norman (1935) and Stacy (1953) believed to contain both Upper and Lower Windsor Group, with the Upper Windsor Group as seen elsewhere in the Province. Bedding is vertical in the section along the shore and therefore most of the unit thicknesses reported by Stacy (1953) are near true. Although several gypsum horizons can be seen, the only one of significance is found at the apparent base of the section (southeastern end) where over 100 m of white to dirty



Geology after Norman, 1935; Keppie, 1979

Figure 9-28. Location and geology of the Port Hood Island occurrence area. See Figures 9-1 and 9-2 for legend and location.

white gypsum with variable intermixed clay can be found. Giles (1982a) believed this section to be fault bound and has not tried to determine its stratigraphic position.

Although the thick gypsum horizon found on Port Hood Island is geologically interesting, it is not of economic interest. The limited areal extent and proximity to homes on the Island would prevent possible development even if sufficient resources could be outlined in the area.

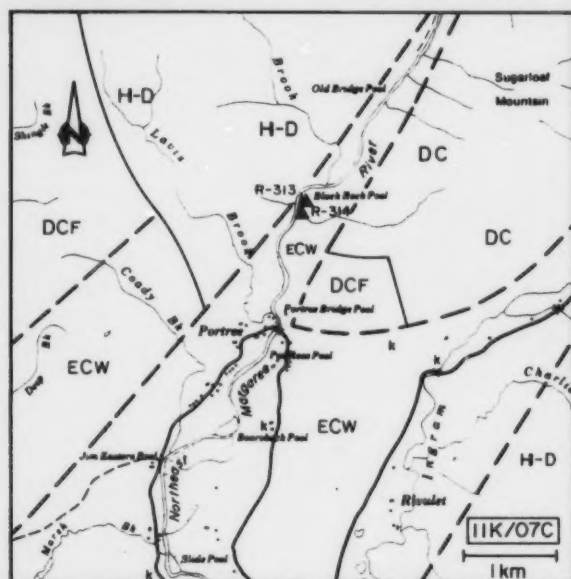
PORTREE (0068)

NTS 11K/07C

UTM 656700 E 5141700 N

The Portree area is located 6 km north of the Village of Margaree Valley, Inverness County (Fig. 9-29). The occurrence consists of two small, light grey, saccharoidal gypsum outcrops found along the eastern bank of the Northeast Margaree River 1.2 and 1.5 km upstream above the bridge at Portree. Kelley (1960) mapped these as undivided Windsor Group strata in fault contact to the east and west with older igneous and metamorphic units. The sulphates are associated with redbed clastic and light brown carbonate interbeds.

Some small areas of apparent karst topography can also be seen to the south and east of Portree, however no outcroppings of gypsum were found in these areas. There is no economic interest in these occurrences which are too small and remote to be of possible commercial value.



Geology after Kelley, 1960; Barr et al., 1987

Figure 9-29. Location and geology of the Portree occurrence area. See Figures 9-1 and 9-2 for legend and location.

RIVER CENTRE (0043)

NTS 11F/14C

UTM 622500 E 5093500 N

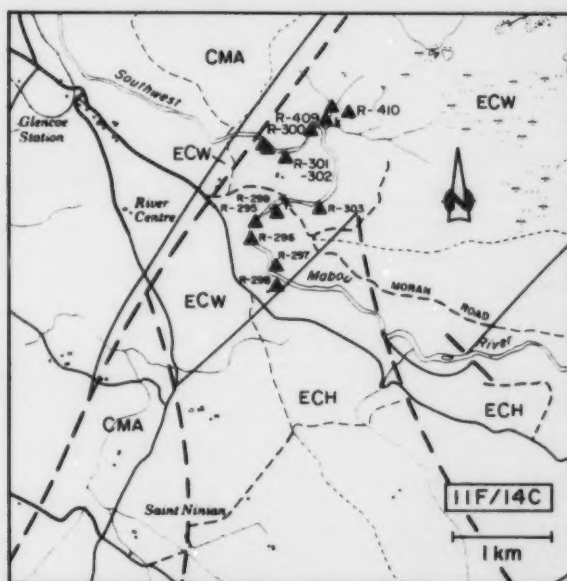
The River Centre occurrence area is located 13 km east of Port Hood, Inverness County (Fig. 9-30). Numerous exposures of gypsum and accompanying areas of karst topography can be found in this vicinity.

Mapped by Kelley (1968a), the area is underlain by units of the undivided Windsor Group which strike northeastward and dip to the west. These are underlain by Horton Group clastics to the south and east and are overlain by clastics of the Canso Group to the west and north. Kelley (1968a) indicated that the Windsor-Horton contact is offset by faulting in this area.

Numerous large exposures of light grey to white gypsum containing variable amounts of intermixed carbonate material can be found in this area. Outcrops of carbonates and clastics found in close proximity to the gypsum exposures suggest that some of this area belongs in Cycle 2 (B Subzone). Faults are present in the expo-

sure indicating that the geology of the area may be quite complex structurally.

The area of greatest interest lies 1300 m downstream along the Southwest Mabou River north of the iron bridge where the Moran Road crosses the River. At this point, two small brooks enter the River from the north and east and karsted terrane extends north of the River for several hundred metres. Although this area is located 45 km north of possible shipping facilities at Port Hawkesbury, additional work should be carried out. Diamond-drilling will be required to determine the extent of hydration in the subsurface as well as the nature of the interbedded material in the sulphates. Analyses of samples indicate high purity gypsum is present (Appendix 3).



Geology modified after Kelley, 1968a

Figure 9-30. Location and geology of the River Centre occurrence area. See Figures 9-1 and 9-2 for legend and location.

RIVER DENYS (0038)

NTS 11F/14A

UTM 642000 E 5076500 N

The River Denys occurrence area is located 29 km northeast of Port Hawkesbury, Inverness County (Fig. 9-31). Geologically, it is an extension of Georgia-Pacific Corporation's Big Brook deposit (0039) which lies immediately to the southwest of this area. Although one small outcrop and some light karst topography can be found in the River Denys area, most of the information available comes from drillhole data.

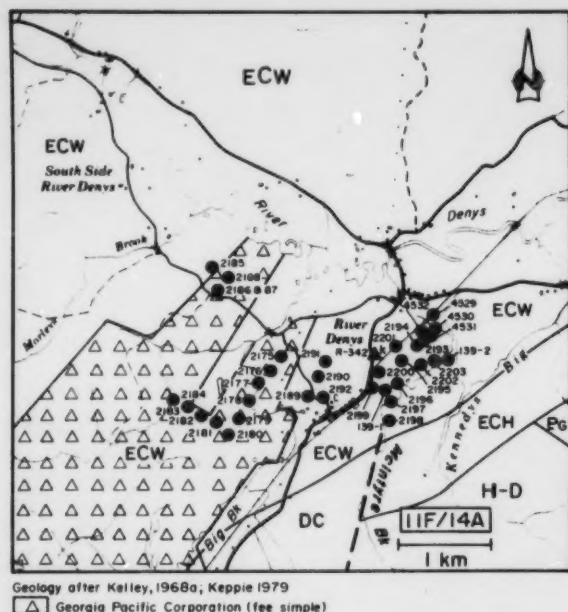


Figure 9-31. Location and geology of the River Denys occurrence area. See Figures 9-1 and 9-2 for legend and location.

Regional mapping by Kelley (1968a) indicated that this area is underlain by undivided Windsor Group sedimentary rocks which thicken towards the northwest. These are underlain by Horton Group clastics to the south and southeast.

A total of 34 diamond-drill holes are known to have been completed in the River Denys area. The Nova Scotia Department of Mines drilled 28 holes in 1956 for Mr. G. Logan who was looking for gypsum (NSDM 2175-2203) (Province of Nova Scotia, 1957e). Unfortunately most of these were shallow and a total of 12 were stopped in overburden. An additional four holes (4529-4532) were drilled in 1968 by the Nova Scotia Department of Mines in search of dolomite (Province of Nova Scotia, 1969b) and two (139-1 and 139-2) were drilled in 1974 by St. Joseph Explorations Ltd. in search of base metals (McCulloch, 1974b). One of the latter was stopped in overburden at 93.3 m.

Most of these holes were drilled between Big Brook and McIntyre Brook, with many of the holes located close to the Brooks. Almost all of the drillholes in

this area encountered thick overburden which possibly is associated with paleokarstification. Because most of the holes are shallow, little stratigraphic correlation can be carried out. The evaporites, with interbedded and interstitial limestone and clastics which were encountered, probably could be placed in Lower Cycle 2 or Cycle 1 (B or A Subzone) of the Windsor Group.

The best shallow gypsum encountered was in hole 2201 which contained 24.4 m of 'white gypsum' with some red clay overlain by 5.5 m of overburden. This area is practically surrounded by areas of heavy overburden in excess of 15 m. Hole 139-2 drilled through a thickness of 34.4 m of gypsum, but this was overlain by 59.4 m of overburden (McCulloch, 1974b).

Much of this area is owned in fee simple by Georgia-Pacific Corporation whose open-pit mine at Big Brook lies immediately to the southwest.

SOUTHWEST MABOU (0022)
NTS 11K/03B
UTM 619400 E 5098400 N

The Southwest Mabou occurrence area is located 7 km southwest of Mabou, Inverness County (Fig. 9-32). Two small outcrops of coarse grained, white gypsum can be found on the western side of the Southwest Mabou River valley. In addition nine drillholes have been put down in this area between 1926 and 1960 (Boehner, 1986). Eastern Gulf Oil drilled five of these, four in

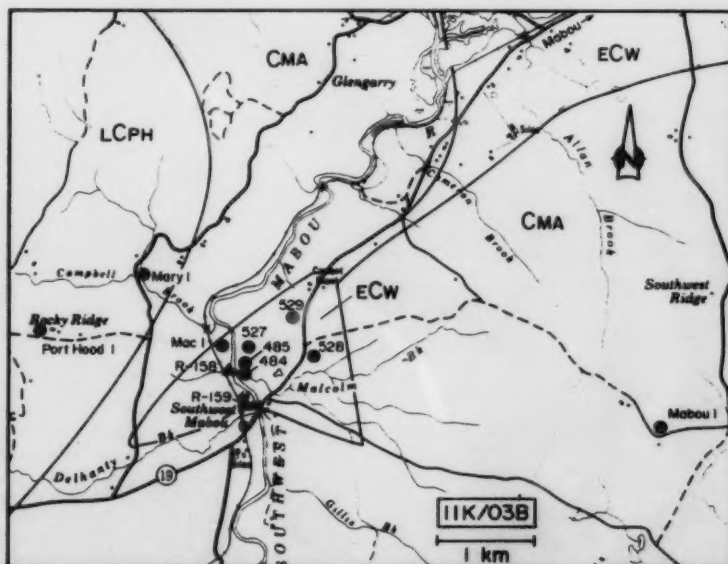


Figure 9-32. Location and geology of the Southwest Mabou occurrence area. See Figures 9-1 and 9-2 for legend and location.

1926 (Province of Nova Scotia, 1927b) and one in 1927 (Province of Nova Scotia, 1928b). Lion Oil Refining Co. drilled two holes in 1944 (MacNeil, 1945). Imperial Oil Ltd. drilled one hole in 1959 and a second in 1960 (Cote and Hill, 1960). All of these holes were drilled to search for oil in the area.

First mapped by Norman (1935), Windsor Group rocks exposed in the Southwest Mabou area have been interpreted using the deep drillhole results available. A number of authors mentioned in Bochner (1986) have described the geological structure of the area to be an anticlinal diapir with thrust or reverse angle faults. Bochner and Giles (1982) interpreted the disturbed intercalated gypsum, limestone, siltstone section which overlies the salt zones to be Cycle 2 (B Subzone) Addington Formation.

Closely spaced drillholes completed by Eastern Gulf Oil in 1926 and 1927 (484, 485, 527, 528 and 529) intersected significant gypsum horizons at shallow depths. However, correlation between these holes, some of which are < 100 m apart, is virtually impossible due to the structurally disturbed nature of the area. This area holds little immediate economic potential for development of gypsum or anhydrite due to the complex nature of the geology of the area.

STONEY POINT (0032)

NTS 11F/14D

UTM 650600 E 5084200 N

Located 4 km east of Orangedale, Inverness County, the Stoney Point occurrence is evidenced by minor karst topography and drillhole data (Fig. 9-33). Regional geological mapping by Kelley (1968a) indicated this area as underlain by undivided Windsor Group rocks.

* Drilling results from the 28 limestone exploration diamond-drill holes completed in 1970 (Murray, 1970) by the Nova Scotia Department of Mines for Sysco showed significant amounts of gypsum in this area. A total of 19 holes bottomed in gypsum and one in anhydrite. The sulphates appear to underlie a thick body (perhaps bed) of dolomite. The thickest evaporite section drilled consisted of 45.6 m of interbedded gypsum and siltstone (17.5% siltstone) overlain by 9.8 m of overburden. The units appear to be Cycle 2 (B Subzone) Windsor Group and their lateral extent is presently unknown.

This locale is geographically restricted, located on a narrow peninsula. However, karst topography just to the west probably indicates a good area for a potential gypsum deposit.



Geology after Kelley, 1968a

Figure 9-33. Location and geology of the Stoney Point occurrence area. See Figures 9-1 and 9-2 for legend and location.

SUGAR CAMP (0041)

NTS 11F/11C

UTM 631000 E 5063000 N

Located 10 km northeast of Port Hawkesbury, Inverness County, Sugar Camp is the site of Georgia-Pacific Corporation's new open-pit gypsum operation (Fig. 9-34). Over the next two or three years this deposit will replace the company's Big Brook deposit as its main source of gypsum. When the quarry goes into full scale operation it will produce approximately 1.0 Mt per annum.

The Sugar Camp deposit lies near the northwestern margin of an extensive Carboniferous basin (Ferguson and Weeks, 1950) which runs from Port Hawkesbury in the southwest to Baddeck in the northeast. This basin is dominated by rocks of the Windsor and Canso Groups which are flanked by Devonian-Carboniferous intrusives to the southeast in North Mountain and Hadrynian metamorphics and intrusives to the northwest in the Creignish Hills.

Georgia-Pacific has carried out an extensive diamond drilling program over the area of its deposit, however little of this information is available at present. Information is available for five drillholes (1-5) completed for G. Logan (Cormier, 1960; Hodge, 1960) and another five drillholes (S-1, S-2, S-3, S-7 and S-8) drilled

for Rio Tinto Canadian Exploration Ltd. in 1974 (Rio Tinto Canadian Exploration Ltd., 1974).

The Sugar Camp mine is located in the basal anhydrite of Cycle 1 (A Subzone) of the Windsor Group. The deposit lies in a northerly trending syncline which plunges to the north. The underlying Horton Group clastic rocks outcrop to the west and again to the east of the area. The Horton uplift or anticline to the east is in turn underlain by pink Devonian-Carboniferous granite which is exposed on Georgia-Pacific's property. Drill-hole information indicates that the basin deepens to the east where significant thicknesses of gypsum and anhydrite can be found.

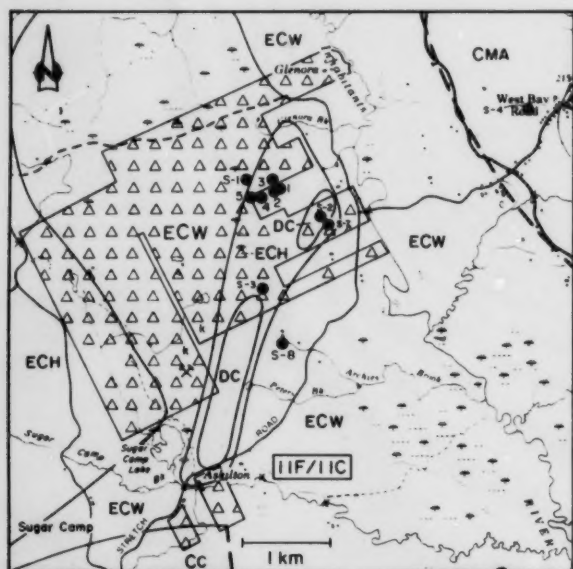


Figure 9-34. Location and geology of the Sugar Camp occurrence area. See Figures 9-1 and 9-2 for legend and location.

Overburden thickness, as in most gypsiferous areas, is quite variable. Generally it is <15 m thick over much of the deposit, but increases to >30 m along the Windsor-Horton contact where solution trenches are commonly found. Typical of Cycle 1 (A Subzone) deposits studied to date, the depth of hydration is somewhat irregular. Gypsum thickness varies from a few metres up to +20 m with deeper hydration found closer to the Horton-Windsor contact (Graham, personal communication).

Gypsum invariably grades to anhydrite with depth over the entire area. Hydration extends to greater depths along the basal anhydrite/Macumber contact where gypsum extends down dip along the contact. The

Cycle 1 sulphate member is in turn overlain by interbedded sulphates, carbonates and clastics to the north as the section thickens. This overlying unit is probably Cycle 2 (B Subzone) of the Windsor Group.

Estimates, using available data, indicate Georgia-Pacific's Sugar Camp deposit may contain in excess of 50 Mt of gypsum which reportedly grades +90% (Graham, personal communication). Road construction for direct access to Route 4 into Port Hawkesbury is in progress. Upon completion this will mean a truck haul of 11 km to company shipping facilities at Point Tupper.

Additional potential for gypsum occurs in this area outside of the Sugar Camp deposit. One drillhole completed by Rio Tinto to the east of the basement high (S-8), encountered 16 m of overburden over 15.5 m of gypsum (Rio Tinto Canadian Exploration Ltd., 1974). This was underlain by a thick anhydrite unit, however numerous gypsum horizons were encountered before the hole bottomed in limestone, then mud and sand at 312.4 m. This eastern area, not presently owned by Georgia-Pacific Corporation, warrants additional drilling.

UPPER MARGAREE (0019)

NTS 11K/03D

UTM 643200 E 5118700 N

The Upper Margaree area is located 12.5 km east of the Town of Inverness, Inverness County (Fig. 9-35). Geological mapping by Norman (1935) placed the

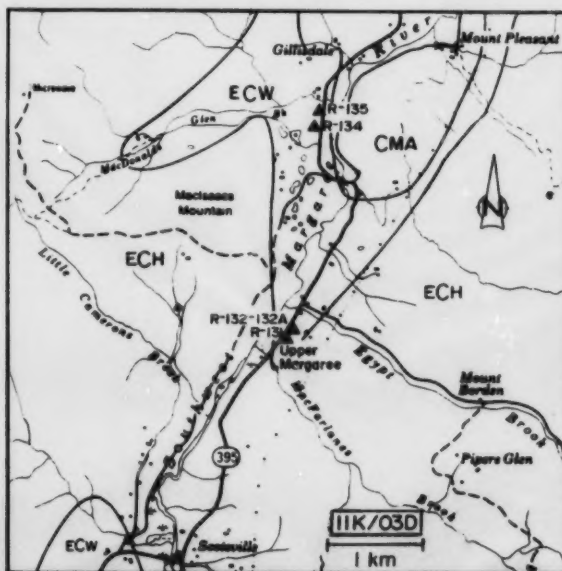


Figure 9-35. Location and geology of the Upper Margaree occurrence area. See Figures 9-1 and 9-2 for legend and location.

several small rounded gypsum outcrops found here in the Lower Windsor Group. The area was mapped as a syncline which plunges to the north with underlying Horton Group clastics to the west and east and overlying Mabou Formation clastics to the north.

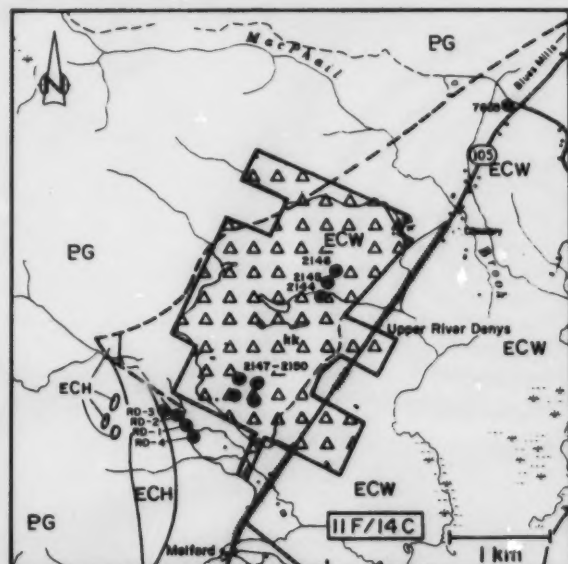
Karst topography is minimal in this area and the gypsiferous area appears not to be extensive. It is doubtful that this area would be of any economic interest.

UPPER RIVER DENYS (0036)

NTS 11F/14C

UTM 635000 E 5082600 N

The Upper River Denys occurrence area is located 31 km north-northeast of Port Hawkesbury, Inverness County (Fig. 9-36). Although karst topography is evident in this area, much of the information available on Upper River Denys comes from drillhole data.



Geology after Kelley, 1968a

△ Georgia Pacific Corp. (fee simple)

Figure 9-36. Location and geology of the Upper River Denys occurrence area. See Figures 9-1 and 9-2 for legend and location.

Regional geological mapping by Kelley (1968a) showed this area to be underlain by undivided Windsor Group rocks. These are underlain by Horton Group clastics to the west and in fault contact with metamorphics of the George River Group to the north.

A total of 12 diamond-drill holes have been completed in this area. Seven holes were completed in 1956 by government drills (2144-2150) for Mr. G. Logan who was drilling for gypsum (Province of Nova Scotia, 1957) for Bestwall Gypsum. Texasgulf Inc. drilled four holes along the Horton-Windsor contact in this area in 1977 (RD-1 to RD-4) in search of base metals (Mann, 1977), and in 1983 the Department of Mines and Energy drilled hole 7655 near Blues Mills to test the potential of Cretaceous deposits (Nova Scotia Department of Mines and Energy, 1984) in this area.

Texasgulf's drilling along the basal Windsor contact encountered solution infill material, the basal carbonate and Horton Group clastics, but no significant gypsum or anhydrite. Logan's drilling, located further out into the basin, encountered what appears to be deeply karsted top of Cycle 1 (A Subzone) and possibly base of Cycle 2 (B Subzone). Typical of gypsum exploration holes, these were not drilled to a stratigraphic horizon, but rather were stopped in anhydrite or when overburden was deemed to be too thick. As a result it is impossible to correlate between drillholes due to a lack of information. The best gypsum section encountered was in hole 2148 where +51 m of gypsum with minor mud seams was overlain by only 6.7 m of overburden. Hole 7655, located approximately 3 km to the northeast of 2148, encountered 93 m of clay before being stopped in a mixture of gypsum and clay at 130 m.

Gypsum in this area appears to be thick and a good grade with only minor interbeds of limestone and clay. Minor interbeds of anhydrite were also encountered. The area lies adjacent to the Trans-Canada Highway 105 and is approximately 32 km from Port Hawkesbury. Georgia-Pacific Corporation owns most of the land in this area.

WEST MABOU HARBOUR (0018)

NTS 11K/03B, 11K/04A

UTM 616400 E 5102850 N

The West Mabou Harbour occurrence is located 8 km west of the Village of Mabou, Inverness County, along the shore south of the mouth of Mabou Harbour (Fig. 9-37). Norman (1935) mapped this faulted sequence of interbedded gypsum, anhydrite, siltstone and limestone as Upper Windsor Group. It is underlain by Lower Windsor Group to the northwest and overlain by clastic sedimentary rocks of the Mabou Formation to the southeast.

Some minor karst topography can be seen inland, however these steeply dipping units do not produce extensive karst. This area is of no economic interest.



Geology after Norman, 1935

Figure 9-37. Location and geology of the West Mabou Harbour occurrence area. See Figures 9-1 and 9-2 for legend and location.

CHAPTER 10. PICTOU COUNTY

LEGEND	
CUMBERLAND GROUP	
LCMR	MIDDLE RIVER FORMATION (LCMR): mudstone, sandstone, and minor conglomerate
RIVERSDALE GROUP	
LCR	Undivided (LCR): siltstone, shale and minor grey quartz wacke
LCBP	BOSS POINT FORMATION (LCBP): sandstone and conglomerate
CANSO GROUP	
ECC	Reddish-brown sandstone and shale (ECC) with intercalated grey banded shale and mudstone (ECC-SM); probable equivalent of the Hastings Formation in the Antigonish area
WINDSOR GROUP	
ECW	Undivided Windsor Group (ECW): red siltstone, mudstone, sandstone, shale, conglomerate, gypsum, anhydrite, halite
ECCV	CHURCHVILLE FORMATION (ECCV): sandstone, shale and mudstone in numerous small-scale fining-upward cycles, typically reddish brown to maroon in colour; intercalated sheets of limestone and associated grey fossiliferous mudstone and shale characteristic and assigned member status: (MQ) MacLean Quarry Member, (MB) McLellan Brook Member, (WB) West Branch Member, (EB) East Branch Member, (I) Island Member
ECFL	FORBES LAKE FORMATION (ECFL): shale, mudstone and paraconglomerate with minor limestone; maroon to pale greyish red colour is typical; (FL-C) conglomerate and sandstone, restricted to the McLellan Brook area (stippled pattern) and considered a proximal facies of the formation, and (FL-S) Sunnybrae Member (oolitic and algal limestone)
~~~~~ disconformity, possible regional unconformity ~~~~~	
<b>ECB</b>	<b>BRIDGEVILLE FORMATION (ECB):</b> gypsum and anhydrite, smoky grey brown in colour, finely crystalline, in part thinly interbedded with limestone and dolostone
<b>ECHB</b>	<b>HOLMES BROOK FORMATION (ECHB):</b> limestone, less commonly dolostone, in part laminated, peloidal and oolitic, thinly stratified; varies to thickly-bedded or massive algal-bound limestone, sparsely fossiliferous, becoming argillaceous and more thinly bedded towards the top; the formation lies with angular unconformity upon pre-Carboniferous rocks
<b>HORTON GROUP</b>	
<b>ECH</b>	Undivided (ECH): medium to dark grey shale, siltstone and fine grained sandstone; noted in the map area only south of the Chedabucto Fault
<b>H-S</b>	Undivided (H-S): mainly grey sparsely fossiliferous and bioturbated siltstones of Silurian age; includes mafic volcanic rocks of possible Hadrynian age in the upper reaches of Stewart Brook and coarsely pyroclastic volcanic rocks of unknown age in the bed of McLellan Brook near Kirkmont; unit includes volcanic and sedimentary rocks of possible Ordovician age in the Black Rock - Sunnybrae area

modified after Giles, 1982b

Figure 10-1. Geological legend for Pictou County gypsum and anhydrite occurrence maps.

SYMBOLS	
Gypsum or anhydrite outcrop	▲
Karst topography	k
Rock sample location	R-253
Drillhole location	J-207
Geological contact	—
Fault	- - -
Thrust fault, barbs point down dip	—▲—
Quarry, active	⊗
Quarry, abandoned	⊙
Anticline	∩
Syncline	∪
Unconformity	—+—+—+—

Figure 10-1. Continued.

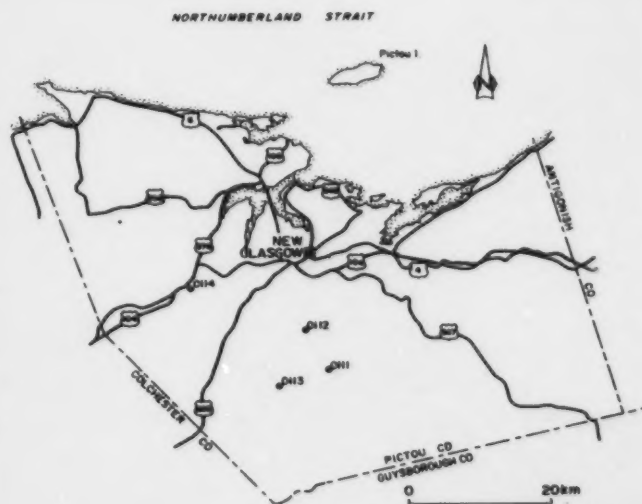
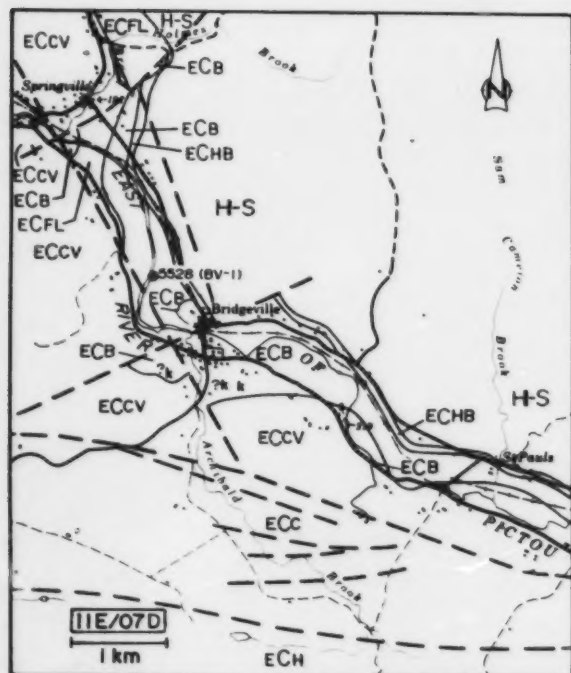


Figure 10-2. Location map for Pictou County gypsum and anhydrite occurrences by reference number.

**BRIDGEVILLE (0111)**  
 NTS 11E/07D  
 UTM 530100 E 5031420 N

The Bridgeville occurrence area is located 15 km south-southwest of the Town of Stellarton, Pictou County (Fig. 10-3). The occurrence consists of subsurface information from diamond-drill hole BV-1 (NSDME 5528) which was completed by Merrill Island Mining Corp. Ltd. in 1971 (Province of Nova Scotia, 1972), as well as an area of possible karst topography south of the Village of Bridgeville.



Geology after Giles, 1982b

Figure 10-3. Location and geology of the Bridgeville occurrence area. See Figures 10-1 and 10-2 for legend and location.

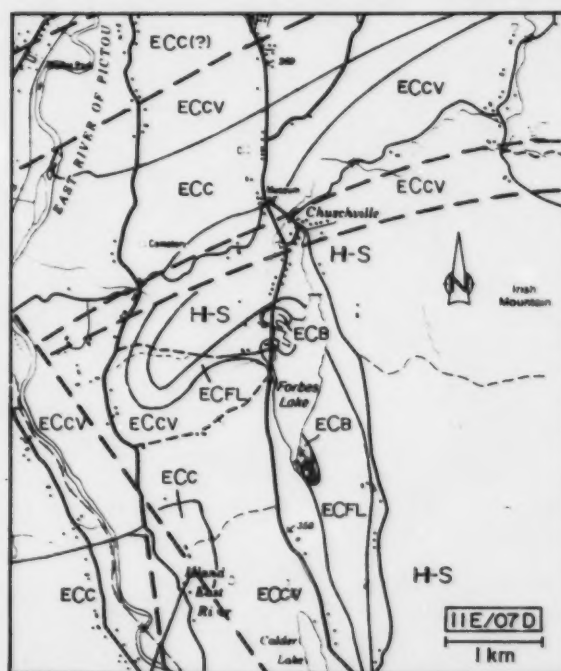
Giles (1982b) mapped the area around Bridgeville as underlain by units of the sulphate dominated Bridgeville Formation of the Lower Windsor Group. These beds, although offset by various faults, strike north-northwestward along the valley of the East River of Pictou and dip to the southwest. They overlie the basal carbonate Holmes Brook (Gays River) Formation, to the northeast which in turn overlies older basement rocks. The Bridgeville Formation is overlain to the west by clastics of the Forbes Lake Formation as well as the Upper Windsor Churchville Formation to the south and west.

Drillhole BV-1, an inclined hole, encountered the following horizons (corrected thicknesses): 22 m of over-

burden, 52.4 m of gypsum, 106.9 m of anhydrite and 12.1 m of basal carbonate before entering the underlying clastics. Although the gypsum thickness encountered is significant the limited areal extent of the Bridgeville Formation in the subsurface would limit the chances of development in the Bridgeville area. Consequently, this occurrence is of geological interest only.

**FORBES LAKE (0112)**  
 NTS 11E/07D  
 UTM 528200 E 5037100 N

The Forbes Lake occurrence is located at the southern end of Forbes Lake and consists of a small area of karst topography with gypsum outcrops, approximately 10 km south of the Town of New Glasgow, Pictou County (Fig. 10-4). A few sinkholes were also reported around the



Geology after Giles, 1982b

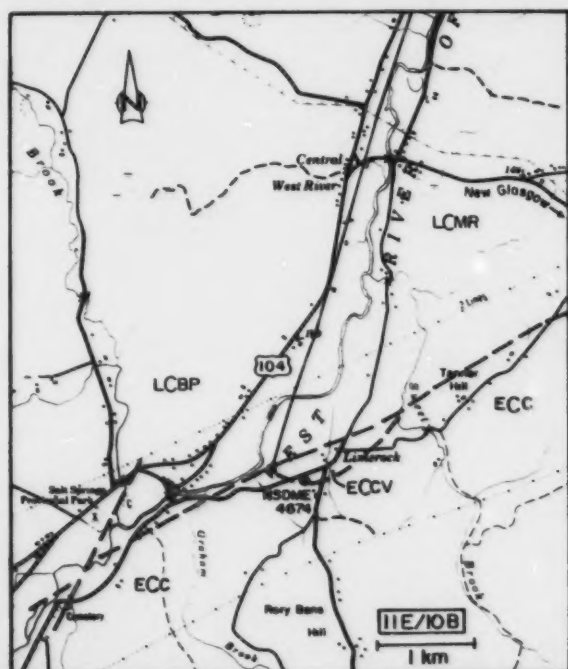
Figure 10-4. Location and geology of the Forbes Lake occurrence area. See Figures 10-1 and 10-2 for legend and location.

northern end of the Lake (Fletcher, 1902). The area is underlain by units of the sulphate dominated Bridgeville Formation (Giles, 1982b). These are surrounded by shales, mudstones and paraconglomerates of the Forbes Lake Formation which are overlain to the west by clastics of the Churchville Formation. This occurrence was noted by Fletcher (1902) and Giles (1982b). However, the area is now part of the New Glasgow Water Supply Area so access is restricted. Although this occurrence was not visited or sampled during the course

of this study, it appears to be geologically similar to occurrences in the western part of the Antigonish Basin (Ohio (0109), Antigonish County).

**LIMEROCK (0114)**  
NTS 11E/10B  
UTM 511600 E 5043500 N

The Limerock occurrence is a subsurface occurrence found in what appears to be a fault-bound block of the Windsor Group situated approximately 16 km west-southwest of the Town of New Glasgow, Pictou County (Fig. 10-5). Murray (1975) drilled four holes at Limerock in 1968. One of these holes, NSDME 4674, encountered gypsum at a depth of 44.3 m and stopped in the same unit at 47.6 m.



Geology after Yeo, 1987

Figure 10-5. Location and geology of the Limerock occurrence area. See Figures 10-1 and 10-2 for legend and location.

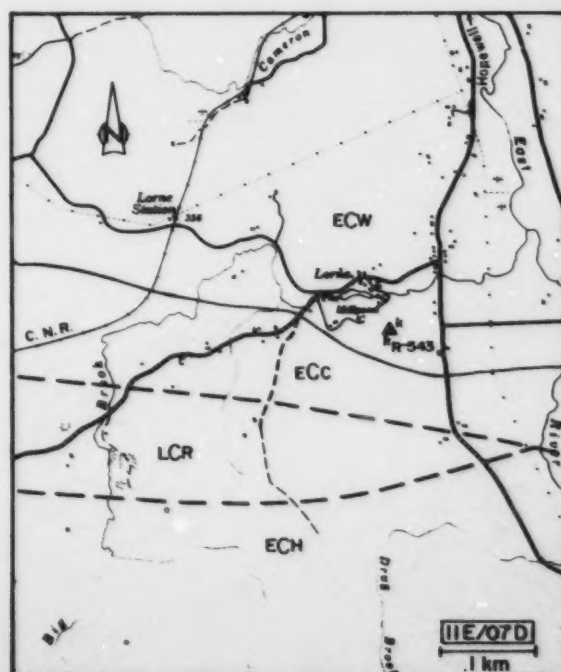
Regional geological mapping by Yeo (1987) indicated that the immediate area is underlain by Upper Windsor Group Churchville Formation. These units are in fault contact to the north with clastics of the Late Carboniferous Cumberland Group (Middle River Formation) and also in fault contact with clastics of the Canso Group to the south. The block of Windsor Group rocks appears to be only 1500 m long by up to 300 m wide, dipping southward under the Canso Group.

Giles (1979) examined the carbonate section found in the Nova Scotia Department of Mines and Energy drillholes at Limerock. He suggested that this limestone could be correlated to the Hebert River Limestone Member which is placed at the base of the Upper Windsor (Moore, 1967). Generally, sulphate horizons found at the top of the Cycle 2 (B Subzone) are thin and make poor economic prospects. This, in combination with the limited areal extent of the Windsor Group at Limerock, make this occurrence a geologically interesting zone, but not of much economic interest.

**LORNE (0113)**  
NTS 11E/07D  
UTM 523350 E 5029700 N

The Lorne occurrence is located 6 km south of the Village of Hopewell, Pictou County (Fig. 10-6). It consists of a small area of light karst topography with numerous small heads containing fine grained, light grey to white gypsum. The property owner (MacQuarrie, personal communication) described plaster production at this site by his grandfather. This material would probably have been consumed locally.

Benson (1967) provided the most recent regional mapping over the immediate area. Some of Benson's



Geology after Benson, 1967

Figure 10-6. Location and geology of the Lorne occurrence area. See Figures 10-1 and 10-2 for legend and location.



(1967) geological interpretations differ with those of Giles (1982b) whose Map 82-3 overlaps the eastern side of Benson's (1967) mapping. That notwithstanding, Benson (1967) showed the Lorne occurrence area to be underlain by undivided Windsor Group rocks which are overlain to the south by clastics of the Canso Group. The Canso Group sedimentary rocks are in fault contact with clastics of the younger Riversdale Group and older Horton Group also to the south. It is not possible, using the available information, to determine what portion of the Windsor Group is found at Lorne.

The areal extent of the gypsum at Lorne appears to be quite limited. Although it is of good quality, the occurrence's size and location, far from any point of shipping or consumption, make it of only minor economic interest. Further work will be required in order to clarify the local Windsor Group stratigraphy as well as the complex structure in this area which is adjacent to the Cobequid-Chedabucto Fault system.

## CHAPTER 11. RICHMOND COUNTY

LEGEND	
<b>RIVERSDALE GROUP</b>	
<b>LCR</b>	Undivided (LCR): siltstone, sandstone, shale, coal, limestone
<b>LCSM</b>	<b>SILVER MINE FORMATION (LCSM):</b> grey-green and grey sandstone with coaly debris, grey-green and red mudstone and siltstone with rare coal
<b>CANSO GROUP</b>	
<b>CC</b>	Undivided (E-LCC): mudstone, shale, sandstone, conglomerate, limestone
<b>CML</b>	<b>MACKEIGAN LAKE FORMATION (E-LCML):</b> grey shale and siltstone with gypsum, anhydrite, red shale and minor limestone and breccia
<b>WINDSOR GROUP</b>	
<b>ECW</b>	Undivided (ECW): red siltstone, mudstone, sandstone, shale, conglomerate, gypsum, anhydrite, halite
<b>ECU</b>	<b>UIST FORMATION (ECU):</b> red siltstone and minor conglomerate with intercalated marine limestone and dolostone and minor gypsum and anhydrite
~~~~~ disconformity ~~~~~	
ECCL	LOCH LOMOND FORMATION (ECCL): gypsum and anhydrite with red siltstone, sandstone and conglomerate and thin marine carbonate beds, rhythmic alternation and rapid facies change of these rock units are typical
ECE	ENON FORMATION (ECE): gypsum, anhydrite, limestone, with minor dolostone, intercalated with red siltstone, sandstone and conglomerate; rhythmic alternation and rapid facies change of these units are typical
~~~~~ disconformity ? ~~~~~	
<b>ECC</b>	Undivided basal conglomerate: red with minor grey-green conglomerate, sandstone and shale with minor nodular limestone; in part equivalent to basal Windsor Group (Subzone A - Major Cycle 1); in the area south of Loch Lomond it may include conglomeratic facies of the Horton Group, in the Enon area it may include conglomerate laterally equivalent to the Enon or Loch Lomond Formations or both
<b>HORTON GROUP</b>	
<b>ECH</b>	Undivided (ECH): medium to dark grey shale, siltstone, and fine grained sandstone
<b>DC</b>	Undivided DEVONO-CARBONIFEROUS ROCKS: grey and minor red sandstone, shale, mudstone and conglomerate; highly indurated, deformed and locally with fracture cleavage
<b>FOURCHU GROUP</b>	
<b>HF</b>	Felsic and mafic tuff, basalt, andesite, rhyolite, slate, quartzite, chlorite schist, metawacke
<b>HCgt</b>	Hadrynian to Ordovician granitoid rocks

SYMBOLS	
Gypsum or anhydrite outcrop	▲
Karst topography	h
Rock sample location	R-253
Drillhole location	J-207
Geological contact	—
Fault	- - -
Thrust fault, barbs point downip	—
Quarry, active	⌘
Quarry, abandoned	⌘
Anticline	⌘
Syncline	⌘
Unconformity	—

Figure 11-1. Continued.



Figure 11-2. Location map for Richmond County gypsum and anhydrite occurrences by reference number.

after Weeks, 1964; Boelner and Prime, 1985

Figure 11-1. Geological legend for Richmond County gypsum and anhydrite occurrence maps.

**DOREYS POINT (0011)**  
NTS 11F/11A  
UTM 646580 E 5042935 N

The Doreys Point occurrence is located 10 km south-southwest of Louisdale, Richmond County (Fig. 11-3). It consists of several blocks of light grey, selenite gypsum with intermixed carbonate material. These are found in a small headland which juts out into Chedabucto Bay.

Regional mapping by Collins (1962) suggested that this area is underlain by undivided Windsor Group units. This occurrence is of geological interest only.



Geology modified after Collins, 1962; Keppie, 1979

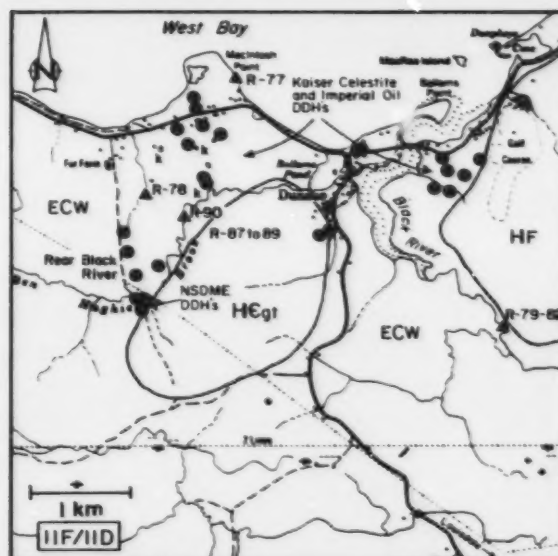
Figure 11-3. Location and geology of the Doreys Point occurrence area. See Figures 11-1 and 11-2 for legend and location.

**DUNDEE (0014)**  
NTS 11F/11D  
UTM 646000 E 5061400 N

The areal extent of this investigation is confined to the areas of Dundee and Rear Black River (Fig. 11-4). Collins (1962) mapped this area as part of his Arichat map sheet. He found the geology to be dominated by interbedded evaporites, carbonates and clastics of the Windsor Group. They are underlain by metamorphic rocks of the Fourchu Group to the east and igneous intrusives to the south. The Windsor Group is in turn overlain by the clastics dominated Canso Group to the west and southwest.

Diamond drilling carried out by Imperial Oil Ltd. in 1972 (MacEachern, 1972) and by Kaiser Celestite

Mining Ltd. in 1972-73 (Forgeron, 1972) defined the presence of two distinct Windsor embayments in the area. Although still connected these areas are separated by a north-south trending basement high which extends north towards McIntosh Point.



Geology after Collins, 1962

Figure 11-4. Location and geology of the Dundee occurrence area. See Figures 11-1 and 11-2 for legend and location.

Windsor Group sedimentary rocks dip into these basins at between 10-15°. Although insufficient stratigraphic interpretation has been undertaken to determine which cycles are present, it is probable that they are Cycle 2 and above (B Subzone and above) with no Cycle 1 (A Subzone) present. Forgeron (1972), in logging core drilled by Kaiser Celestite, described some of the limestone members at Dundee as resembling the "Bun" and "B₂" limestones seen at Loch Lomond.

In addition to substantial gypsum and anhydrite beds, a thick basal limestone (probable reef buildup) is present in the western embayment along the western flank of the north-south trending basement high. Also, celestite is known to occur in the eastern embayment under the gypsiferous section which is adjacent to the basement rocks of the Fourchu Group.

Both Windsor embayments at Dundee contain significant gypsiferous sections with over 60 m of mixed gypsum, siltstone and limestone. The eastern section, however, is deeply cut by the Black River which would greatly restrict any opportunity for open-pit mining in this area. Widespread karst topography covers the western area where gypsum thickness exceeds 30 m in

places. Overburden does not exceed 20 m and is generally <15 m. Some solution collapse occurs in the upper parts of the gypsum beds and anhydrite underlies all horizons basinward. Insufficient drillhole information is available to determine reserves in the area, however a conservative estimate, using an average thickness of 18 m thick by 600 m wide by 1500 m long, would yield in excess of 40 Mt. Possible reserves further to the west are unknown because no diamond drilling has been carried out in that direction. This area warrants additional investigation.

**HAY COVE (0004)**  
NTS 11F/10D  
UTM 677000 E 5067750 N

The Hay Cove occurrence area is located along the valley of Toms Brook, 15 km northeast of St. Peters, Richmond County (Fig. 11-5). It consists of numerous exposures of light grey to white gypsum containing minor amounts of intermixed carbonate as well as extensive karst topography along the southern side of the valley.

Regional geological mapping by Weeks (1955; 1964) indicated that this area is underlain by undivided "central basin beds" of the Windsor Group. Shea and Murray (1969) indicated that limestones found upstream on Toms Brook belong to Cycle 1 (A Subzone) of the Windsor Group. Weeks (1955; 1964) suggested that these units are underlain to the south and east by older

clastics of the Horton Group and are in fault contact to the northwest with Upper Windsor Group clastics and carbonates.

Extensive exposures of good quality gypsum and moderate to heavy karst topography along the valley of Toms Brook west of Route 4 generate economic interest in this area. In addition two small white and orange gypsum exposures can be found 2 km to the west of Route 4 at Scotch Point. Further investigation of the area along Toms Brook is warranted and should include diamond drilling. Although some distance from possible shipping points, the area is adjacent to the Bras d'Or Lakes which could permit shipments by barge or small bulk carrier.

**LENNOX (0010)**  
NTS 11F/11A  
UTM 653435 E 5049300 N

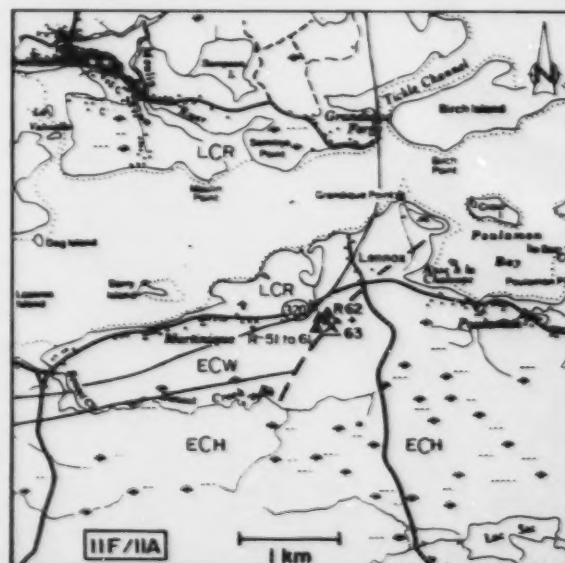
The Lennox occurrence is found 7 km by road southeast of the Village of Louisdale, Richmond County (Fig. 11-6). According to Collins (1962) the area is underlain by a narrow band of Windsor Group evaporites which are overlain by clastics of the Riversdale Group to the north and in turn overlie Horton Group clastics to the south.

A large block of gypsum can be found at this locale where 10 200 t of gypsum were mined between 1884 and 1894 (Nova Scotia Department of Mines, Annual



Geology after Weeks, 1955; 1964; Kappie, 1979

Figure 11-5. Location and geology of the Hay Cove occurrence area. See Figures 11-1 and 11-2 for legend and location.



Geology after Collins, 1962; Kappie, 1979

Figure 11-6. Location and geology of the Lennox occurrence area. See Figures 11-1 and 11-2 for legend and location.



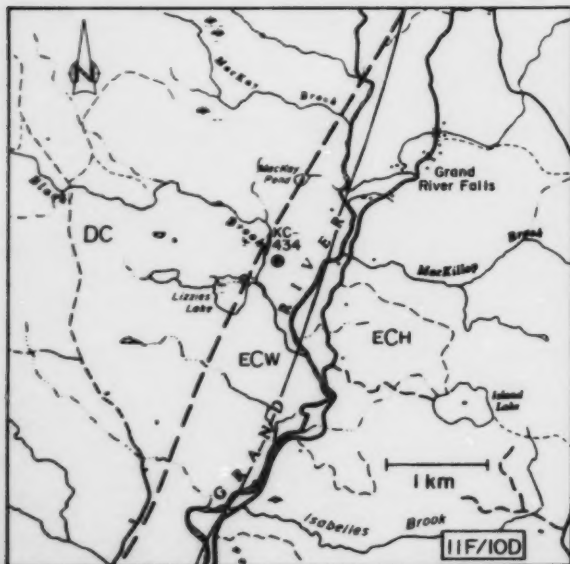
Reports, 1885-1895). Although no drilling has been carried out in the area an approximate estimate of 2 Mt is given for the remaining reserves at Lennox. Additional work is warranted which could determine whether additional development might be possible in the future.

**LIZZIES LAKE (0030)**  
NTS 11F/10D  
UTM 683880 E 5062470 N

The Lizzies Lake occurrence is located 21 km east-northeast of St. Peters, Richmond County (Fig. 11-7). The occurrence consists of a section of gypsum and apparent solution infill material intersected in a drillhole located just northeast of Lizzies Lake. The hole was put down in 1975 by Kaiser Celestite Mining Ltd. (Forgeron, 1976) as part of a celestite exploration program.

Keppie (1979) showed that the Windsor Group is in fault contact to the west with the Devonian-Carboniferous and underlain by Horton Group to the east.

Insufficient information is available to properly assess the potential of this area. The apparent solution feature encountered by Kaiser's drillhole is encouraging, however the lack of karst topography and remote location of this occurrence makes it of more geological than economic interest.

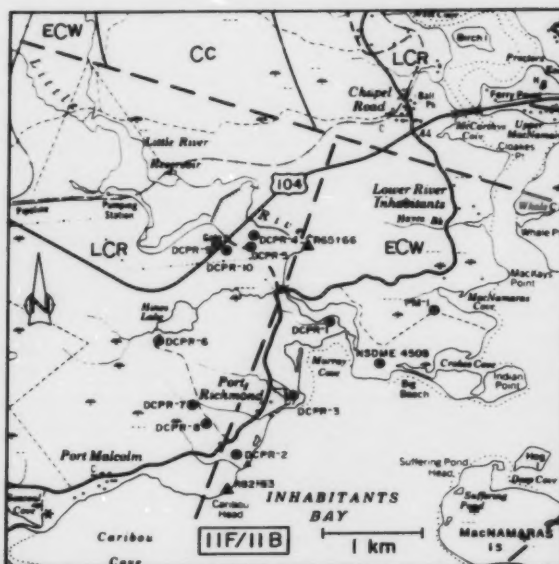


Geology after Keppie, 1979

Figure 11-7. Location and geology of the Lizzies Lake occurrence area. See Figures 11-1 and 11-2 for legend and location.

**PORT RICHMOND (0042)**  
NTS 11F/11B  
UTM 637420 E 5050370 N

The Port Richmond occurrence area is located 7 km due east of Point Tupper, Richmond County (Fig. 11-8). Some small gypsum outcrops can be found in this area, but most of the available information is derived from drillhole data. A total of 12 holes were completed in the area as part of salt exploration between 1967 and 1975, 11 by Dow Chemical Company of Canada and one by Dew Mining Corporation (NSDME 4508) (Boehner, 1986).



Geology after Ferguson and Weeks, 1950; Boehner, 1986

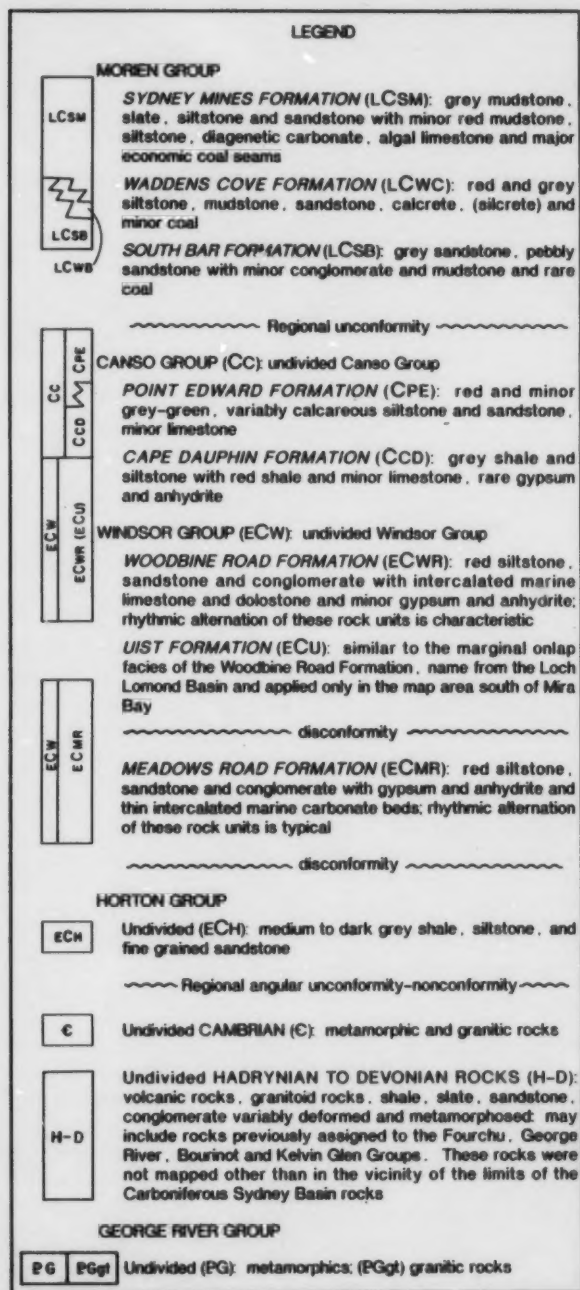
Figure 11-8. Location and geology of the Port Richmond occurrence area. See Figures 11-1 and 11-2 for legend and location.

Regional geological mapping by Ferguson and Weeks (1950) and Collins (1962) indicated that this area is underlain by a fault-bound block of undivided Windsor Group rocks. Much younger clastics of the Riversdale Group can be found to the north, east and west of this Windsor Group block.

Boehner (1986) discussed this area in detail. He found that much of the area is underlain at depth by salt and that the overlying Windsor Group strata are intensely deformed. Some gypsum and anhydrite intervals were encountered at depth in a number of holes, however the prospects for discovering economically interesting intervals of either mineral is unlikely.

No additional work on this area is recommended.

## CHAPTER 12. VICTORIA COUNTY



modified after Boehner and Giles, 1986

Figure 12-1. Geological legend for Victoria County gypsum and anhydrite occurrence maps.

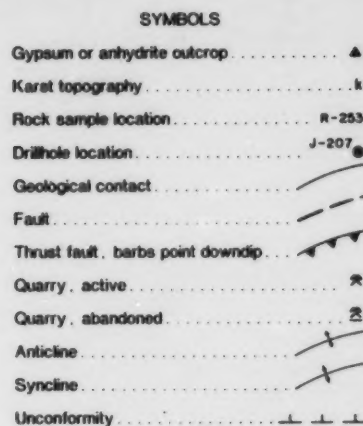


Figure 12-1. Continued.



Figure 12-2. Location map for Victoria County gypsum and anhydrite occurrences by reference number.

**BIG HILL (0078)**  
 NTS 11K/02D  
 UTM 682000 E 5114000 N

The Big Hill area is located 10 km east-northeast of the Village of Baddeck, Victoria County (Fig. 12-3). Outcrops can be seen along the Trans-Canada Highway 105 at Glen Tosh; beside a secondary road between Big Hill and Plaister Mines; as well as along Big Harbour Brook. In addition, two diamond-drill holes (BH-1 and -2) were completed in the area by Asarco Exploration Company of Canada Ltd. in 1974 (Cameron, 1974).

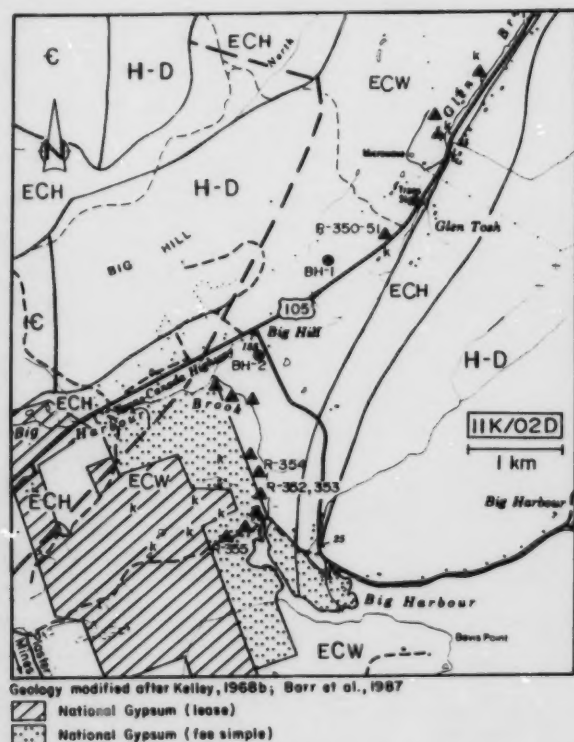


Figure 12-3. Location and geology of the Big Hill occurrence area. See Figures 12-1 and 12-2 for legend and location.

Regional geological mapping by Kelley (1968b) and Barr et al. (1987) showed the area to be underlain by undivided Windsor Group sedimentary rocks which are underlain to the east and northeast by Horton Group clastics and to the west and northwest by Horton Group clastics and older metamorphics. This defines a north-easterly trending synform which widens in the Big Hill

area, extending southeast at Big Harbour towards Boularderie Island.

Occurrences on the surface in the Big Hill area consist mainly of fine grained, massive, light blue anhydrite similar to that seen in the St. Anns Harbour area (0077). These are locally hydrated to fine grained, massive, white gypsum of high purity (+90%). Asarco's (Cameron, 1974) two drillholes were both abandoned in anhydrite at depths in excess of 230 m below surface. Minor interstitial silt and carbonate described in these cores are common in Cycle 1 (A Subzone) of the Windsor Group. Carbonate outcrops in Big Harbour Brook, in the western portion of the area, towards Baddeck Bay, indicate the presence along the Horton-Windsor contact of a Meaghers Grant type facies underneath the basal sulphate.

Little drilling has been carried out in this area to date so it is not possible to assess the full economic potential of the Big Hill area. The surface outcrop and drillhole intersections of the basal sulphate unit give evidence of the vast amounts of sulphates available here, however the observed hydration appears to be limited to the near surface. Should hydration be enhanced by clastic interbeds or by fault structures in the area, then the potential for sizable deposits of high purity gypsum would be very good in this occurrence area. The area is also highly prospective as a source for high purity, fine grained, massive anhydrite. The Big Hill area has excellent potential for substantial anhydrite deposits as well as gypsum, but requires further drilling.

**BOULARDERIE CENTRE (0002)**  
 NTS 11K/02D  
 UTM 692000 E 5120000 N

This area is located approximately 3 km south-southwest of the Seal Island Bridge, on the southwestern shore of Boularderie Island (Fig. 12-4). Several small (1-2 m²) outcrops of white gypsum can be found along the waters edge in this area and hummocky terrane can be seen on the overlying area.

Boehner and Giles (1986) determined this area to be underlain by the Meadows Road Formation dipping to the east and south at 25-27° into a syncline which runs the length of Boularderie Island. This occurrence is of geological interest only.





stratigraphic studies have been undertaken in the area, it is believed that these rocks belong to Cycle 1 (A Subzone) of the Windsor Group. Sulphates dominate the Windsor Group in the Dingwall area with only minor interbeds of limestones and clastics in the section.

National Gypsum drilled 20 holes (DDHs 1142-1161) in the area of one of the mines at Dingwall in 1946 (Province of Nova Scotia, 1947b). All holes were collared directly in gypsum with no overburden. Apart from one hole which bottomed in gypsum at 25.9 m, the greatest thickness of gypsum drilled was 8.2 m. All holes passed through generally thin gypsum layers into anhydrite below.

In 1975 Asarco Exploration drilled eight holes (AR-1 to AR-8) in the Dingwall area in search of base metals (Cameron, 1975). The best gypsum intersection was in hole AR-1 which encountered 19.5 m of gypsum before encountering a zone of mixed gypsum and anhydrite then anhydrite below. Overburden in the area is generally shallow, around 8 m or less except where solution cavities were encountered.

Substantial amounts of gypsum and anhydrite remain accessible to mining in the Dingwall area. Shallow overburden and apparently gently dipping strata would make these deposits amenable to open-pit mining, however shipping problems resulting from siltation in Dingwall Harbour remain a serious hindrance to development in the area.

#### **FORKS BADDECK (0072)**

NTS 11K/02C

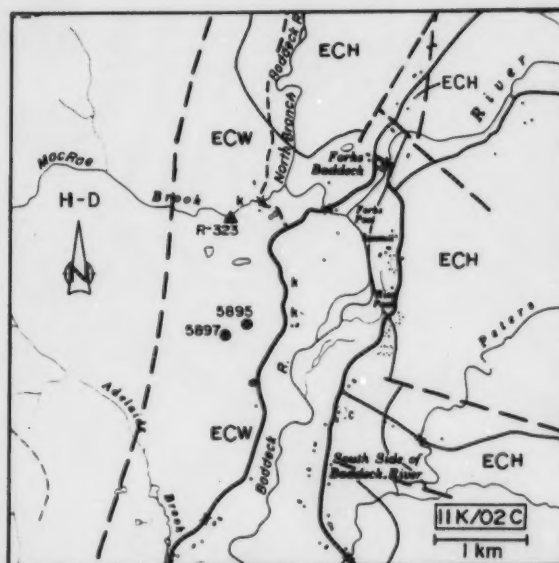
UTM 670660 E 5115660 N

Forks Baddeck is located 8 km north of the Village of Baddeck, Victoria County (Fig. 12-6). The occurrence consists of a small outcrop of pinkish-white, nodular gypsum on the southern side of MacRae Brook, 700 m upstream from where the Brook empties into the North Branch Baddeck River. Numerous probable sinkholes can also be found in the immediate area north of the Brook. Further karst is evident along an apparent northerly trending Windsor-basement contact.

Geological mapping by Kelley (1968b) placed the rocks of this area in the undivided Windsor Group. These are underlain to the north and east by Horton Group clastics and in fault contact to the west with Devonian or earlier intrusives. Kelley (1968b) found the area to be extensively faulted with the Windsor-Horton contact offset in many places. No stratigraphic interpretation has as yet been attempted on the Windsor Group units.

Two drillholes, completed in this area in 1972 by a Nova Scotia Department of Mines core drill for DEVCO (Record Nos. 5895, 5897) encountered interbedded siltstone, limestone and minor gypsum (Province of Nova Scotia, 1975a). These units probably belong to the Upper Windsor, however no correlations were attempted at the time of drilling and the present location of the core is unknown.

This area and its occurrence is of geological interest only. Little or no development potential exists at the present time in the Forks Baddeck area.



Geology modified after Kelley, 1968b

Figure 12-6. Location and geology of the Forks Baddeck occurrence area. See Figures 12-1 and 12-2 for legend and location.

#### **FRENCH RIVER (0088)**

NTS 11K/08C

UTM 695950 E 5152200 N

The occurrence at French River consists of two separate outcrop areas approximately 900 m apart (Fig. 12-7). They are located just west of the Cabot Trail, 25 km north of Englishtown, Victoria County.

Originally mapped by Bell and Goranson (1938) with recent updating of the basement rocks by Barr et al. (1987), the area is shown to be underlain by a fault-bound block of undivided Windsor Group units. These are underlain to the east and west by Horton Group clastics.

Only the southern outcrop area was sampled; the second can be observed from the Cabot Trail and in



airphotos of the area. The southern outcrop includes a cliff face in excess of 10 m in height which runs north-northeast for about 100 m. It is composed of high purity, white, fine grained gypsum over high purity, blue-grey anhydrite. A taller slope covers the base of this face. Karst is heavy in the area immediately west of the face, but diminishes away from the face toward the west. The block of sulphate ends abruptly about 150 m west of the first face. The two areas probably represent a continuous unit of Cycle 1 (A Subzone) material. MacInnis Brook flows between these outcrop areas and probably has eroded away the intervening section.

The French River outcrop areas are of minor economic interest due to their limited size, however they should be the subject of additional investigation to determine the true extent of the gypsum as well as the purity and extent of the underlying anhydrite.

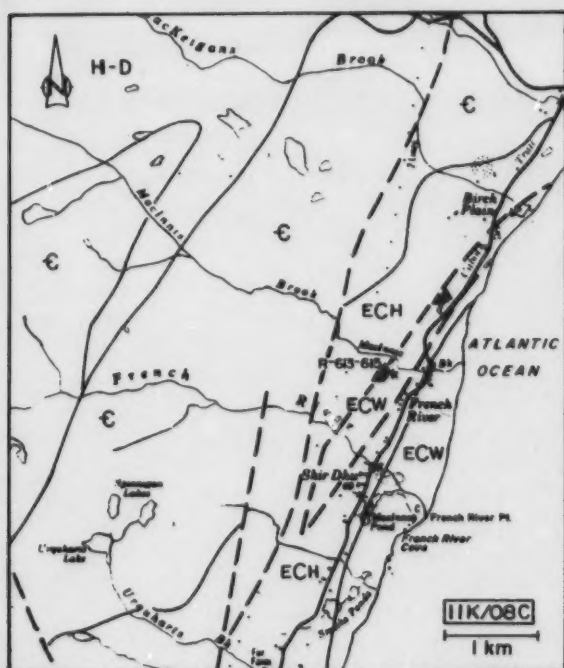


Figure 12-7. Location and geology of the French River occurrence area. See Figures 12-1 and 12-2 for legend and location.

**HUNTERS MOUNTAIN (0079)**  
NTS 11K/02B  
UTM 666400 E 5007840 N

The Hunters Mountain occurrence is located near the mouth of the Baddeck River, approximately 6 km west of the Village of Baddeck, Victoria County (Fig. 12-8).



Geology modified after Kelley, 1968b

Figure 12-8. Location and geology of the Hunters Mountain occurrence area. See Figures 12-1 and 12-2 for legend and location.

A small outcrop of fine grained, light grey gypsum can be found along an old woods road north of the River. Numerous small sinkholes occur just north of the area.

Regional mapping by Kelley (1968b) described the area as a northeasterly trending band of undivided Windsor Group sedimentary rocks in fault contact with Horton Group clastics to the northwest and younger clastics of the Canso Group to the southeast. Very few outcrops can be found in the immediate area and no drillhole information is available to further substantiate the regional mapping interpretation.

The Hunters Mountain occurrence is, at this time, solely of geological interest. Limited karst in the area extends to the northeast and may warrant some further investigation to determine its extent. A small drilling program could be carried out to define the sulphate units in the area and the extent of their hydration.

**INGONISH BEACH (0075)**  
NTS 11K/09C  
UTM 698800 E 5168200 N

The occurrences around Ingonish Beach are found within the Village of Ingonish Beach along the beach area south of Keltic Lodge and east of the Cabot Trail (Fig. 12-9). Gypsum was produced at Ingonish Beach in

the past. Production was reported between 1925 and 1929 totalling 240 568 t (Nova Scotia Department of Mines, Annual Reports, 1926-1930).

Recent geological mapping in the area by Barr et al. (1987) combined with that of MacLaren (1956b) which differentiated the Horton and Windsor Groups, constitutes the extent of geological mapping in the Ingonish Beach area. Stratigraphic interpretation of the Windsor Group units has not been attempted, however the sulphates seen at this location appear to belong to either Cycle 1 or 2 (A or B Subzone).

Although the gypsum found at Ingonish Beach is of good quality, it appears to be of limited areal extent and most of the immediate area is presently inhabited. The occurrences here are of geological interest only.



Figure 12-9. Location and geology of the Ingonish Beach occurrence area. See Figures 12-1 and 12-2 for legend and location.

**IONA (0084)**  
**NTS 11F/15C**  
**UTM 669400 E 5094600 N**

The Iona occurrence area is located just north of the Village of Iona, Victoria County (Fig. 12-10). It includes all the Windsor Group outcroppings from Plaster Cove north to Blacksmith Point, from the shore of Great Bras d'Or inland to Barra Glen.

Nova Scotia Department of Mines, Annual Reports recorded that gypsum was produced from a deposit at Grass Cove between 1914 and 1932 excluding 1918. Total production was 95 513 t, all of which was calcined in a plant on the site and shipped via boat and train to markets as far away as New Zealand.



Geology modified after Weeks, 1955; Clemis, 1978; Keppie, 1979  
 Fundy Gypsum (see sample)

Figure 12-10. Location and geology of the Iona occurrence area. See Figures 12-1 and 12-2 for legend and location.

Regional mapping by Weeks (1955) showed that, except for a small granite body to the north, all of this area was underlain by units of the Windsor Group. This interpretation has since been refined, and mapping carried out by Amax Exploration Inc. (Clemis, 1978) indicated that units of the Cycle 1 (A Subzone) Windsor Group basal sulphate and basal carbonate seen locally are underlain or in fault contact to the west and south with Horton Group clastics. These clastics were included by Weeks (1955) in the Windsor Group.

Unfortunately, no diamond-drill holes appear to have been completed in the area which might have passed through the sulphate horizons into underlying rocks. Outcrops and karst areas are confined to the Grass Cove and Plaster Cove areas. High purity gypsum appears to be the surface hydration of the underlying high purity anhydrite which can be seen in some exposures. Much of the area is deeply eroded leaving little area available for further gypsum exploitation.

According to King (1985), Fundy Gypsum Company Limited still owns three small parcels of land in this area

including the Grass Cove Quarry area. This fact, in addition to the apparently limited vertical and areal extent of hydration, would greatly diminish the potential for future development.

**ISLAND POINT (0050)**  
NTS 11K/02D  
UTM 690000 E 5111500 N

Island Point, on the southern side of Boularderie Island, is underlain by Lower Carboniferous rocks of the Windsor Group Meadows Road Formation (Bochner and Giles, 1986) (Fig. 12-11). These strata dip to the northwest and are overlain by clastic sedimentary rocks of the Upper Windsor Group Woodbine Road Formation and the Morien Group South Bar Formation.



Figure 12-11. Location and geology of the Island Point occurrence area. See Figures 12-1 and 12-2 for legend and location.

A total of 12 diamond-drill holes were completed in the area in 1956, however it is not yet known which company had this work performed (Domtar Gypsum, confidential company report). Drill results established that a thin cap of limestone, about 3 m thick covers the gypsum on the northern end of Island Point. The thickness of the gypsum varies from 6.1-18.3 m and hydration often extends below the high tide mark. Domtar Chemicals Limited, when investigating the property in 1968, estimated a minimum of 10.9 Mt of gypsum reserves on it (Domtar Gypsum, confidential company report). The sole analysis found from Island

Point had a gypsum content of 96.6% (Domtar Gypsum, confidential company report). Previous investigation by Curry (1945) estimated a greatly diminished tonnage figure for the area of 4.5 Mt. Differences could be attributable to the additional subsurface information available to Domtar at the time of its investigations.

The Island Point deposit is located on deep water and has accessibility via St. Andrews Channel to the Bras d'Or Channel out of the Bras d'Or Lakes. Difficulties could arise from mining an island with much of the gypsum lying below the high tide level. This area is rapidly being developed as cottage lots, a fact which may prevent any resource development in the future.

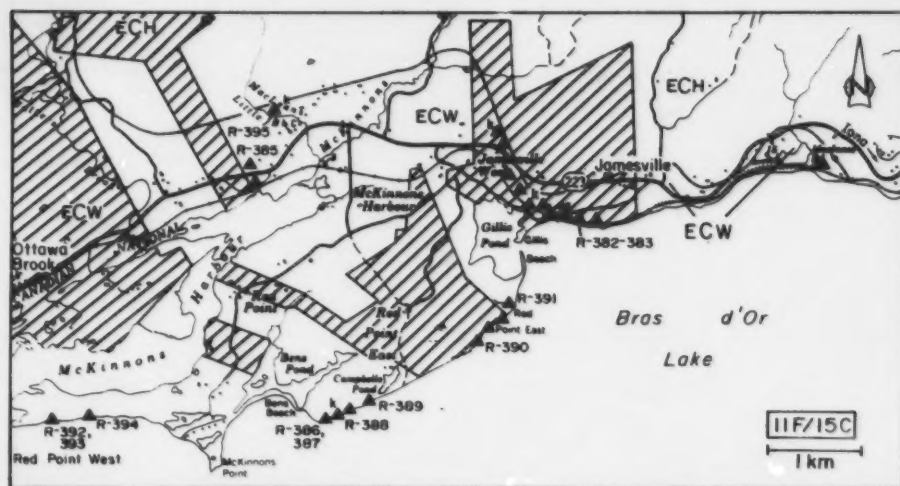
**JAMESVILLE (0085)**  
NTS 11F/15C  
UTM 665600 E 5089700 N

The Jamesville occurrence area is located from 2-9 km west of the Village of Iona, Victoria County (Fig. 12-12). It extends from Iona (0084) in the east to Ottawa Brook (0083) in the west, Cains Mountain in the north to the shores of Bras d'Or Lake in the south. The area is an extension of the Ottawa Brook occurrence area to the west.

Weeks (1955) mapped this area as part of his Grand Narrows map sheet. He mapped all of the units as Windsor Group. More recent work (Clemiss, 1978) assigned the clastic rocks found in the northern part of this occurrence area to the Horton Group which underlies the Windsor. Some of Amax Exploration Inc.'s drillhole evidence from the Ottawa Brook occurrence area (0083) also suggested that the Horton/Windsor contact may be, in some places, a faulted relationship (Clemiss, 1978). Since no drillhole information exists in this area, it is not possible to determine the true nature of this contact.

Portions of the basal sulphate of Cycle 1 (A Subzone) can be seen in outcroppings along the shore of Bras d'Or Lake and the Canadian National Railway line at Jamesville and east at MacInnis Pond. Further to the southwest along the shore at Red Point East and Red Point West sections of interbedded, sulphates, carbonates and siltstones can be found. Most of the units exposed at Red Point East strike approximately east-west and dip moderately to the south (20-30°); at Red Point West near Ottawa Brook similar units strike slightly more to the southeast. These probably represent units of Cycle 2 (B Subzone) or above, however no detailed stratigraphic interpretation has been undertaken in the area.





Geology modified after Weeks, 1955; Clemiss, 1978

Legend: National Gypsum (lease)

Figure 12-12. Location and geology of the Jamesville occurrence area. See Figures 12-1 and 12-2 for legend and location.

Little opportunity exists for development in the Jamesville occurrence area. The Cycle 1 (A Subzone) sections present are usually only hydrated to a few metres where exposed and areas of deeper hydration which are indicated by karst topography are limited in extent. The potential Cycle 2 (B Subzone) areas are generally very low lying and are found along the shores of Bras d'Or Lake. MacKinnons Harbour, a prominent topographic feature in the area is probably a reflection of dissolution of a portion of the Windsor Group units in the area. Nonetheless a few drillholes in the Red Point East area would help to clarify the geology and the economic potential for gypsum and anhydrite in this occurrence area.

#### JUBILEE (0086)

NTS 11F/15C

UTM 658100 E 5093600 N

The Jubilee occurrence area is located 2-3 km southeast of the Village of Little Narrows, Victoria County (Fig. 12-13). It encompasses all surface and subsurface sulphate occurrences found between the Little Narrows area (0087) to the north and northeast, and the Ottawa Brook area (0083) to the south.

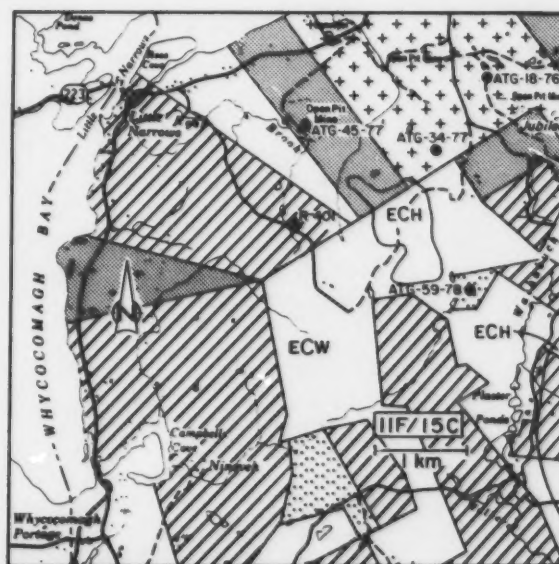
Some minor gypsum production has occurred in this area in the past, however it would have been reported with the Little Narrows figures and is not considered here. The Jubilee area has been the subject of base metal investigations since the mid 1930s and as a result a total of 115 drillholes have been completed in the area. Much information is available on the Cycles 1

and 2 (A and B Subzones) units which underlie much of this locale.

Regional geological mapping for this area was included in Weeks, 1955; Kelley, 1968b; and Clemiss, 1978. The area is dominated by a Horton Group high (Clemiss, 1978) surrounded by units of the Cycle 1 (A Subzone) of the Windsor Group. Although the Horton-Windsor contact is in some places faulted by northwesterly trending structures, it appears to be conformable (Stewart, 1978). These Windsor Group units are also

underlain by Horton clastics to the southeast in the vicinity of Cains Mountain.

Although exploration at Jubilee took place between the mid 1930s and late 1970s the majority of drilling was



Geology modified after Weeks, 1955; Clemiss, 1978

Legend: National Gypsum (lease)

National Gypsum (fee simple)

Little Narrows Gypsum (lease)

Little Narrows Gypsum (fee simple)

Figure 12-13. Location and geology of the Jubilee occurrence area. See Figures 12-1 and 12-2 for legend and location.

carried out by Getty Mining, Amax Exploration and Texasgulf Canada Limited between 1972 and 1979 (Hein et al., 1988). Hein et al. (1988) used the drillhole data to propose the existence of a horst which trends north-westward from the Horton high as well as a second horst along the eastern flank of the high. Maximum vertical displacement along any of these structures appears to be <170 m with displacement diminishing to the northwest along all structures. Cross-sections drawn from drill logs of holes peripheral to the Horton-Windsor contact show the dips of that contact into the surrounding basins to be gentle in all directions. These dips vary from 0-20° to the west, northwest, north and northeast, to 10-15° to the east through south of the Horton high.

Virtually all of the drilling in the Jubilee occurrence area encountered the thick sulphates and minor carbonates of the Cycle 1 (A Subzone). Holes as far to the northwest as ATG-45-77 collared in this Cycle (Clemiss, 1978). More distant drillholes towards the northwest unfortunately were triconed. Undoubtedly some of these would have contained some materials from the Cycle 2 or above (B Subzone or above).

Surprisingly, hydration to gypsum of the basal anhydrite in the Jubilee area is minimal. Elongated ponds or lakes and adjacent cliff exposures around the Horton high are evidence of a typical dissolution zone along the Horton-Windsor contact, however there do not appear to be any areas of thick gypsum to be found. The prominent northwesterly trending structures evident in the area would commonly provide excellent plumbing for hydration in the basal sulphate, but again the numerous drillholes in the area encountered few areas of extensive hydration. Maximum hydration encountered along the basal contact was 34.75 m in hole ATG-59-78 (southeast of the Horton high) and numerous holes encountered 3-5 m of gypsum adjacent to northwesterly trending faults. Elsewhere hydration was usually <3 m in thickness.

Development potential for gypsum in the Jubilee area is limited. Although possibilities do exist for small deposits along the basal contact areas which have not yet been drilled, most of the gypsum rights are held by large gypsum companies. Potential for anhydrite in this area is excellent with large tonnages of fine grained, high purity anhydrite available at or near surface. Virtually all of the Jubilee occurrence area is held by companies and individuals under mining lease (Little Narrows Gypsum Co. Ltd.), development licence (Canamax Resources and Lionel York), or exploration licences in addition to the gypsum rights holdings seen on Figure 12-13.

**KELLYS COVE (0049)**  
**NTS 11K/08B**  
**UTM 697000 E 5129500 N**

The Kellys Cove occurrence is located 7 km northeast of the Seal Island Bridge, at the base of Kellys Mountain in Victoria County (Fig. 12-14). No evidence of gypsum can be seen on the surface in this area, however gypsum was intersected by drilling during Scotia Limestone's 1978 investigation of the area for dolomite (MacNeil, 1978).



Geology after Bochner and Giles, 1986

Figure 12-14. Location and geology of the Kellys Cove occurrence area. See Figures 12-1 and 12-2 for legend and location.

Regional geological mapping by Bochner and Giles (1986) showed that a small block of interbedded clastics, carbonates and gypsum underlies a portion of the Kellys Cove area. These units belong to the Woodbine Road Formation of the Windsor Group. They are in fault contact with older metamorphosed dolomite to the west and are overlain by clastics of the Canso Group to the east.

One drillhole, KC-1, passed into Windsor Group strata at depth and through a single gypsum horizon. MacNeil (1978) interpreted these beds to be steeply dipping to the east. A total of 21 m of gypsum was cored in this hole, with a true thickness in the order of 16.2 m.

The steeply dipping nature of the beds and lack of areal extent of the Windsor Group at Kelys Cove would suggest that there is limited potential for development of gypsum. This occurrence is of geological interest only.

**LITTLE NARROWS (0087)**  
 NTS 11F/15C  
 UTM 659000 E 5095500 N

Little Narrows has been the site of gypsum production since 1936 (Fig. 12-15). Originally held by the Iona Consolidated Gypsum Corporation (Domtar Gypsum,

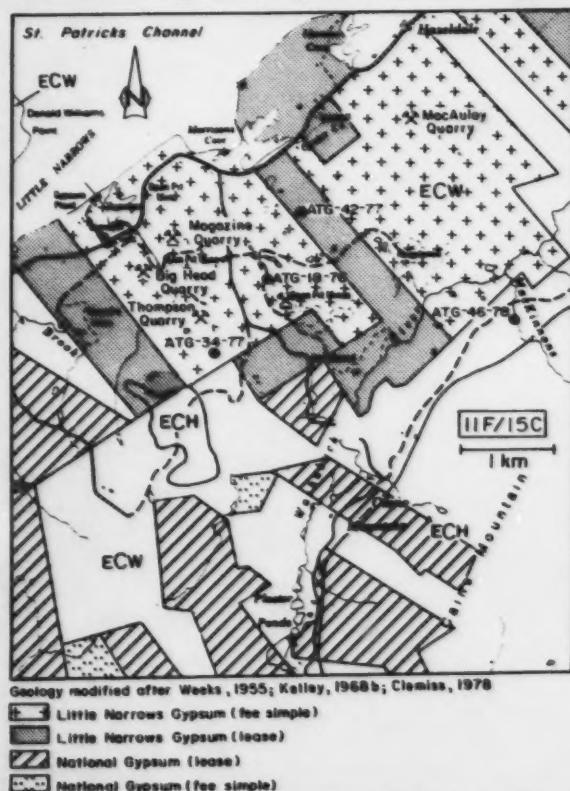


Figure 12-15. Location and geology of the Little Narrows occurrence area. See Figures 12-1 and 12-2 for legend and location.

confidential company report) construction of facilities commenced in 1935 under the name of the Victoria Gypsum Company Limited (King, 1985). It produced gypsum at Little Narrows until 1954 when, in December, its properties and gypsum holdings were sold to the Little Narrows Gypsum Company Ltd. Production has continued to the present under this Company name.

Between 1936 and 1987 a total of 21 408 429 t of gypsum and 1 460 335 t of anhydrite were produced

(Nova Scotia Department of Mines and Energy, Annual Reports, 1937-1988). The majority of this material was extracted from the Magazine Quarry, which is at present almost exhausted, as well as numerous other smaller sites in the area. Operations were halted from 1943-1945 inclusive due to labour and transportation shortages caused by World War II. The highest annual production rate for gypsum at Little Narrows was 1 113 955 t in 1988 (Nova Scotia Department of Mines and Energy, 1989). Gypsum and anhydrite are shipped in crude form from the Little Narrows site on company owned and chartered vessels to destinations in Quebec, Ontario and the United States eastern seaboard.

The deposits at Little Narrows are located in a moderately disturbed sequence of Lower Windsor Group rocks (Cycles 1 and 2 (A and B Subzones)) just north of the Jubilee Horton high (0086). These units are overlain by Upper Windsor Group rocks (Cycles 3 and above (Subzones C and above)) to the north and west and underlain by Horton Group clastics to the south and southeast. The Windsor strata trend roughly northeasterly in this area and dip to the northwest under St. Patrick's Channel. Northwestward trending high angle faults noted at Jubilee (Hein et al., 1988) have also been observed in the Little Narrows area (Holleman, 1976).

The quarry areas at Little Narrows have been extensively drilled and stratigraphic interpretations made in order to facilitate mining, however very little of this information is publicly available. Holleman (1976) is the most useful reference presently available on the deposit area.

According to Holleman (1976) and Lewis and Holleman (1983) the main production quarry, up until 1990, the Magazine Quarry, lies within interbedded sulphate, carbonate and siltstone near the base of Cycle 2 (B Subzone) of the Windsor Group. The Big Head Quarry, southwest of the Magazine, and the Thompson Quarry, south of the Magazine, both produce lesser amounts of gypsum and anhydrite from the thick massive sulphate units near the top of the Cycle 1 (A Subzone). The exact geological relationship between these Quarries cannot be determined with the available information, however the presence of northwesterly trending high angle faults might explain the close proximity of the thick A Subzone sulphates at the Big Head Quarry and the interbedded B Subzone section at the Magazine Quarry 300 m away. The structure of the units in the Magazine Quarry was described by Holleman (1976) as a broad syncline plunging 17° to the northwest. A northward trending, high angle fault was also noted by Holleman (1976) along the eastern margin of the Quarry, but no estimate of the amount of displacement



was found. It was noted that the block to the east was uplifted relative to the Quarry section.

Records are available for only four diamond-drill holes in the Little Narrows area. All of these, completed during the base metal exploration work around the Jubilee area, are widely separated and not very near the active quarries. Hole ATG-18-76 was located approximately 700 m along strike northeast of the Thompson Quarry and was collared and completed in massive anhydrite (Clemiss, 1978). Located approximately 300 m south of the Thompson Quarry, hole ATG-34-77 was collared in anhydrite and passed through 100 m of anhydrite before encountering the basal carbonate and underlying Horton. Hole ATG-42-77, located about 1000 m east of the Magazine Quarry was collared in B Subzone or above and passed through 180 m of interbedded siltstone, carbonate and sulphate before encountering the thick basal sulphate. Hole ATG-46-78 was drilled in the eastern portion of the Little Narrows area. It is located near the Windsor-Horton contact and encountered sulphates and infill material in the solution trench before entering the Horton Group at around 118 m (Clemiss, 1978).

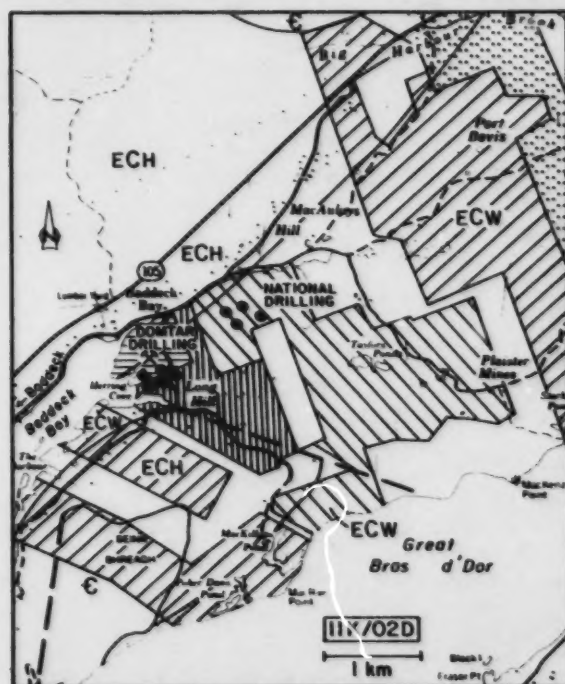
In general the Windsor Group rocks found in the Little Narrows area dip gently and thicken towards the northwest in the direction of St. Patricks Channel. These units are offset by high angle, northwesterly trending faults, the frequency of which is not known. Some folding is also noted in the interbedded Cycle 2 (B Subzone) units.

Over the past few years the Little Narrows Gypsum Company Ltd. has begun to develop a new quarry known as the MacAulay Quarry. It is located approximately 2 km northeast of the Magazine Quarry and appears to be the same geological section (Cycle 2 (B Subzone)) as was mined in the Magazine Quarry. Less information is available on this area than on the Magazine and therefore no conclusions can be drawn as to the potential reserves which may exist there. This area projects into the Washabuck Bridge region (0080). It is interesting to note that much work has been done at the Little Narrows plant site in recent years to refurbish those facilities.

Vast amounts of high purity anhydrite are available on the Little Narrows property. This includes the Thompson and Big Head Quarries where much material is already exposed and readily available.

**LONG HILL (0186)**  
NTS 11K/02D  
UTM 679000 E 5110500 N

The Long Hill deposit area, for the purposes of this description, includes those areas lying between Baddeck Bay to the west and Plaister Mines to the east, Highway 105 to the north and the Great Bras d'Or Channel to the south (Fig. 12-16). This area is located 5 km northeast of the Village of Baddeck, Victoria County.



Geology modified after Kelley, 1968a; Barr et al., 1987

- National Gypsum (lease)
- National Gypsum (fee simple)
- Damsel (lease)
- Damsel (fee simple)
- Republic Gypsum (fee simple)

Figure 12-16. Location and geology of the Long Hill occurrence area. See Figures 12-1 and 12-2 for legend and location.

Gypsum was produced from quarries in this area as far back as the mid 1870s when Duncan MacDonald of Montreal operated a small quarry "west of Plaister mines..." (Jennison, 1911). Another small operation was run by the Victoria Gypsum Mining and Manufacturing Company at Port Bevis in the 1890s (Jennison, 1911). Unfortunately production records maintained by the

Nova Scotia Department of Mines during those days were incomplete. Later in the 1920s through the early 1940s, gypsum was produced from a quarry at Long Hill (Red Head or Herring Cove, historical names). First set up by the North American Gypsum Company Ltd. in 1927, this property was taken over by the Gypsum, Lime and Alabastine Co. (GLA) in 1939 and finally became the property of Domtar Gypsum in 1959 (King, 1985). It was operated from 1927-1941 during which time a total of 90 662 t were produced (Nova Scotia Department of Mines, Annual Reports, 1928-1942).

Virtually all of this area is owned or has its gypsum rights leased by gypsum companies. Most of these holdings have changed hands a number of times over the years (King, 1985), but no gypsum has been produced here since 1941. National Gypsum (Canada) Ltd., Domtar Gypsum and Republic Gypsum all currently hold gypsum rights over portions of this area.

During the 1950s and early 1960s Domtar Gypsum and its predecessors drilled numerous holes in the area of the old GLA Quarry. In 1956, National Gypsum drilled a total of 84 diamond-drill holes on a property which was held at that time by H. B. McCurdy and now is held by Republic Gypsum immediately to the east of Domtar's property. Although much of Domtar's drilling information is not publicly available, the National data were submitted to the Nova Scotia Department of Mines by Republic Gypsum Co. in 1969 (Oldale, 1969) and constitutes the bulk of the geological information available on the area.

Regional geological mapping by Kelley (1968b) and Barr et al. (1987) indicated that much of this area is underlain by units of the undivided Windsor Group. These form a low-lying easterly trending synform in the area of Long Hill which widens to the east towards Plaister Mines and northeast towards Port Bevis. The Windsor Group is underlain by older Horton Group clastics which form more resistant promontories to the north-northwest and south-southwest of Long Hill. These contacts are either unconformable or faulted. This area resembles Georgia-Pacific Corporation's Sugar Camp deposit (0041), Inverness County, where Cycle 1 (A Subzone) Windsor Group is found lying between two Horton Group areas and the intervening calcium sulphate horizon is deeply hydrated.

All of the drilling carried out in this area by several companies is confined to an area 2000 m northeast and southeast of the old GLA Quarry at Long Hill. Overburden is generally <15 m thick over much of this area, however deeply eroded and infilled solution trenches are

seen along the Windsor-Horton contacts. Hydration depths are also greatest along these contacts and can exceed 50 m at some points, although gypsum thicknesses in the order of 30 m are much more common. Outcrops in the area are dominated by anhydrite with thin gypsum surface-hydration caps. These can be seen paralleling the Windsor-Horton contact in the area south of Taylors Ponds and are described by Oldale (1969).

Although many of the drillholes in the Long Hill area encountered some mudstone or sandstone intervals within the hydration zone, these sections appear to consist of postdepositional infill material. No drilling or surface evidence of these interbedded carbonates, calcium sulphates and clastics of the Cycle 2 (B Subzone) of the Windsor Group have been noted in this area. Most of the gypsum seems to be the hydrated basal anhydrite of the Cycle 1 (A Subzone), deepest along the Windsor-Horton contact and in part removed and infilled after hydration. Oldale (1969) covered the results of National Gypsum's 1956 drilling program in some detail. Gypsum thickness and anhydrite top contour plans and cross-sections help one to visualize the deposit. He concluded that the 'North Zone' of Republic's property contains up to 23.6 Mt of gypsum. This, in addition to the reserves defined on Domtar's property, represents a significant potential resource.

Development of the abundant gypsum and anhydrite present in the Long Hill area will be dictated by nongeological factors, specifically cultural and environmental concerns. Domtar Gypsum attempted to gain public support for a mining project which would have reopened a quarry at the old GLA site in late 1987, early 1988. Initially, local response was quite favourable; however, in the end, residents of the Baddeck area argued that such an operation would detract from the scenic nature of an area whose primary industry is tourism. Domtar decided to put its plans on hold and has since put its efforts into other properties. Development of the gypsum reserves in the adjacent property held by Republic Gypsum will probably run into the same opposition as the Domtar project. All other factors, such as quality of stone, overburden thickness, loadout sites and shipping make this area ideal for development.

#### LOWER WASHABUCK (0081)

NTS 11K/02B

UTM 673600 E 5104340 N

The occurrence at Lower Washabuck consists of one small block of silty, selenitic, medium- to coarse-grained, light grey to orange gypsum found along the shore of St. Patricks Channel just south of Bone Island (Fig. 12-17).

A minor area of gently rolling karst can also be seen at this locale.

Kelley (1968b) mapped this area as underlain by undivided Windsor Group sedimentary rocks which are in turn underlain by Horton Group clastics to the south. It is not possible to determine what portion of the Windsor is present at this locale, however it is probably units of Cycle 1 (A Subzone).

No economic potential is envisaged at Lower Washabuck because the waters of St. Patrick's Channel cover most of the area believed to be underlain by the Windsor Group. Insufficient exposure exists to make this occurrence of interest geologically.

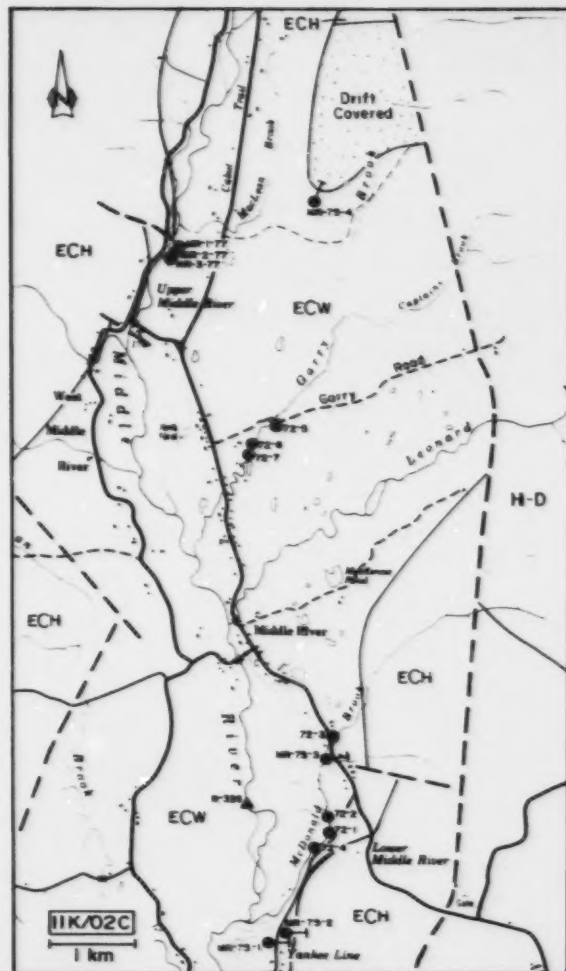


Geology modified after Kelley, 1968b

Figure 12-17. Location and geology of the Lower Washabuck occurrence area. See Figures 12-1 and 12-2 for legend and location.

**MIDDLE RIVER (0074)**  
NTS 11K/02C  
UTM 660280 E 5111640 N

The Middle River area is located 15 km west and north of the Village of Baddeck, Victoria County (Fig. 12-18). The Cabot Trail transects the valley of Middle River which dominates the local topography. Overburden is thick in the valley and surface occurrences are rare with only one gypsum outcrop found in an area of approximately 40 km² underlain by rocks of the Windsor Group. Numerous drillholes have encountered sulphates in the Middle River area.



Geology modified after Kelley, 1968b; Barr et al., 1987

Figure 12-18. Location and geology of the Middle River occurrence area. See Figures 12-1 and 12-2 for legend and location.

The Nova Scotia Department of Mines drilled a series of holes for DEVCO in the Middle River area in 1972-73, three of which encountered gypsum and anhydrite (72-2, 72-4 and 72-5) (Province of Nova Scotia, 1975b; 1975c). Getty Mines Ltd. drilled in the area in 1975 and again in 1977 as part of a base metal exploration program (Bryant, 1975). Four out of seven of these holes encountered gypsum and anhydrite (MR-75-3, MR-75-4, MR-2-77 and MR-3-77). Drilling was distributed over three areas, Upper Middle River, Garry Road and Lower Middle River (Fig. 12-18).

Regional geological mapping by Kelley (1968b) described the Middle River area as undivided Windsor Group sedimentary rocks in a general synform, underlain



to the west, northwest and southwest by clastics of the Horton Group. They are also in fault contact with Devonian or older igneous rocks to the east, northeast and southwest. Bryant (1975) concluded that the Cycles 1, 2 and probably 3 (A, B and probably C Subzones) of the Windsor were present in the drilling and that these units were gently folded (axis north-south) and faulted.

Thick overburden in the area masks much of the karst topography which would normally be evident over gypsiferous zones. The drillholes which encountered sulphates indicate that hydration has occurred to considerable depths (maximum 288.59 m in hole MR-75-3) (Bryant, 1975). Although stratigraphic interpretations of the area need to be refined it appears that Cycles 1 and 2 (A and B Subzones) are present in the Middle River section.

Gypsum has been mined from Cycles 1 and 2 (A and B Subzones) at Little Narrows Gypsum Company Ltd.'s Little Narrows Quarry (0087) for many years. Therefore the deep hydration seen in some portions of the Middle River area make it a prospective area for additional work.

**NORTH SHORE (0076)**  
NTS 11K/08C  
UTM 694000 E 5143000 N

The occurrence at North Shore is located along the coast of St. Anns Bay in the vicinity of the Plaster Picnic Park (Fig. 12-19). This Park is 16 km north along the



Geology modified after Bell and Goranson, 1938, Barr et al., 1987

Figure 12-19. Location and geology of the North Shore occurrence area. See Figures 12-1 and 12-2 for legend and location.

Cabot Trail from the Englishtown, Victoria County. Approximately 700 m of discontinuous, high purity, fine grained, white and light blue gypsum and anhydrite outcrop can be seen along the shore. At the southern end of the exposures the sulphates are apparently underlain to the west by badly weathered red to grey-green siltstones. North of the Park area, along the shore, there appears to be a faulted block of Horton Group sandstone between two sulphate blocks (not shown on map).

Geological mapping in the area by Bell and Goranson (1938) and Barr et al. (1987) concluded that undivided Windsor Group rocks are dipping steeply eastward along the shore in the occurrence area, in fault contact with Horton Group clastics to the west and overlain by clastics of the Canso Group to the east. The units seen at North Shore appear to be members of the Cycles 1 or 2 (A or B Subzones).

As is the case elsewhere along this shore, the sulphates found are of good quality, however there appears to be an insufficient volume of material present to be of economic interest. The exposures seen at North Shore are of geological interest.

**OTTAWA BROOK (0083)**  
NTS 11F/15C  
UTM 659000 E 5090000 N

The Ottawa Brook occurrence area lies 3-4 km south of the Village of Little Narrows, Victoria County (Fig. 12-20). It includes all surface and subsurface occurrences from Whycocomagh Portage in the west to Cains Mountain in the east, from Nineveh in the north to McKinnons Harbour in the south. It represents a continuation of the Jubilee occurrence (0086) to the north and the Jamesville occurrence (0085) to the east.

Historical records (Nova Scotia Department of Mines, Annual Reports, 1908-1928) showed that gypsum was produced in the Ottawa Brook area between 1907 and 1927 or 1928. Although production figures are not available for this whole period, they were recorded for 14 years at total production 396 092 t. These reports mentioned as many as five sites operating at one time including one underground. However, the majority of the gypsum was mined from one elongated pit located about 600 m north of the Canadian National Railway trestle at Ottawa Brook. Stone was moved by a small rail line to loadout facilities on McKinnons Harbour 1.6 km south of the quarry. The Newark Gypsum Company (Newark Plaster Co.) ran this operation for the 20 years that it was active.

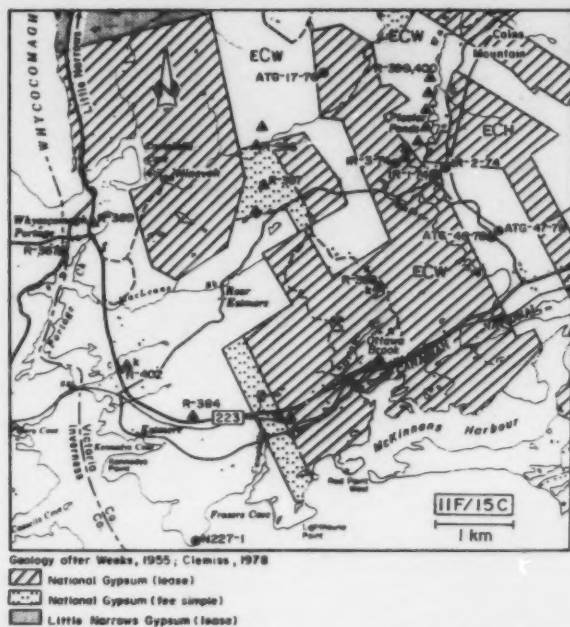


Figure 12-20. Location and geology of the Ottawa Brook occurrence area. See Figures 12-1 and 12-2 for legend and location.

Weeks (1955) carried out the regional mapping of this area as part of his Grand Narrows map. Base metal exploration in the area, carried out principally by Amax and Texasgulf during the 1970s has greatly increased the detail of the local geological mapping (Clemiss, 1978). Recent work by Hein et al. (1988) contains additional geological information on the Jubilee area (0086) to the north.

Most of the Ottawa Brook occurrence area is underlain by units of the sulphate dominated Cycle 1 (A Subzone) of the Windsor Group. These are underlain by clastics of the Horton Group to the east and overlain to the south and west by younger (Cycle 2 (B Subzone) and above) Windsor Group sedimentary rocks towards the deeper portions of the basin.

A typical Cycle 1 (A Subzone) sequence can be observed at Plaster Ponds. Drillhole IR-2-74 contains basal Windsor carbonate resting on Horton conglomerate. IR-1-74 passed through a portion of the dissolution trench and IR-3-74 encountered +290 m of basal sulphate (Amax Exploration Inc., 1977-78).

Outcrops to the south in the area of the old quarry at Ottawa Brook are interbedded red clastics, minor carbonates as well as sulphate horizons. Airphotos of

the area indicate contorted bedrock features in the quarry area which probably reflect the dissolved sulphate horizons. All evidence suggests that these units are probably part of Cycle 2 (B Subzone).

Drillholes ATG-47-78 and ATG-48-78, located south of Cains Mountain, on the eastern side of the Ottawa Brook occurrence area, were completed near the Windsor-Horton contact (Clemiss, 1978). Hole ATG-47-78 encountered what was described as a fault zone containing brecciated carbonates, clastics and sulphates near the Horton-Windsor contact. Approximately 150 m to the southwest of hole ATG-47-78, hole ATG-48-78 encountered interbedded carbonates, sulphates and minor clastics (Clemiss, 1978). This section may belong to Cycle 2 (B Subzone) or above as well. Further detailed work is required to determine the direction and displacement of the faulting in this area.

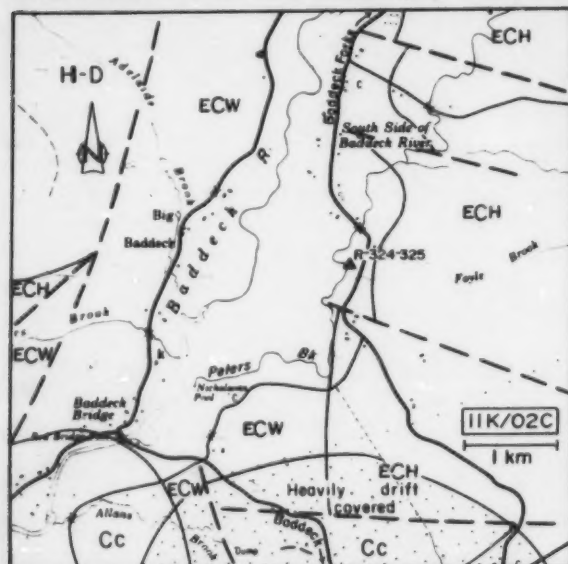
The deepest drillhole in the area (N227-1) is located at Estmere where, in 1981, Noranda Exploration drilled to a depth of 860 m as part of a regional potash exploration program (Cooper, 1981). This hole which intersected a section of saline evaporites, is believed to have collared in units of the Cycle 3 (C Subzone), and was abandoned in the upper part of the Cycle 1 (A Subzone) due to drilling difficulties.

Development potential for gypsum in the Ottawa Brook occurrence area is fair to good. Cycle 1 (A Subzone) units are very common here, however the line of small lakes called Plaster Ponds probably represents what was once a very large body of gypsum which has been dissolved. Elsewhere the amount of surface hydration of the basal sulphate appears to be quite limited. Units of Cycle 2 (B Subzone) in the vicinity of the old Ottawa Brook Quarries probably hold some potential for development. Much additional work would be required to determine what resources might be present. Unlimited tonnages of high purity anhydrite are present in this area particularly between Plaster Ponds and Jubilee.

The gypsum rights for the western and southern portions of this area are held under lease agreements by National Gypsum (Canada) Ltd. (Fig. 12-20). A few small blocks are also held by National in fee simple. These holdings would limit the possibilities of gypsum production by other companies, but should not interfere with anhydrite because it is a mineral under the Mineral Resources Act and subject to licensing. The main line of the Canadian National Railway runs through the area and shipping possibilities exist via the Bras d'Or Lakes.

**PETERS BROOK (0073)**  
**NTS 11K/02C**  
**UTM 671960 E 5111700 N**

The Peters Brook occurrence is 4 km north of Baddeck, Victoria County, on the eastern bank of the Brook approximately 400 m downstream from the paved road between Baddeck and Forks Baddeck (Fig. 12-21). The



Geology modified after Kelley, 1968b; Barr et al., 1987

Figure 12-21. Location and geology of the Peters Brook occurrence area. See Figures 12-1 and 12-2 for legend and location.

exposure consists of a discontinuous outcrop approximately 100 m long of massive, fine grained, light brown to yellow limestone overlain by a nodular, light grey to white gypsum which is overlain by a white, laminated gypsum unit. The gypsum is concealed above and is 3 m thick at this point. Bedding, taken from the carbonates is 000/23°W. A block of light brown fossiliferous limestone can be seen at the northern end of the outcrop area.

Regional mapping by Kelley (1968b) included the occurrence in undivided Windsor Group rocks. These are underlain to the east by Horton Group clastics and are in fault contact with Devonian (or older) intrusives to the west. The Windsor units probably belong to the Cycle 2 (B Subzone), however further work would be required to substantiate this, because to the north Kelley (1968b) believed the Windsor-Horton contact to be offset by faulting at numerous points.

A few probable sinkholes are evident in this area which for the most part lies within the Valley of the Baddeck River. The occurrence itself is of geological interest only.

**PONYS POINT (0082)**  
**NTS 11K/02B**  
**UTM 672800 E 5100000 N**

The Ponys Point occurrence consists of several gypsum outcroppings over 1 km long along the southern side of the Washabuck peninsula, northeast of Ponys Point (Fig. 12-22). Several smaller (1-5 m high by 5-50 m long) exposures of fine- to medium-grained, high purity, white to light grey gypsum are scattered along the shore.



Geology modified after Kelley, 1968b

▨ National Gypsum (lease)

Figure 12-22. Location and geology of the Ponys Point occurrence area. See Figures 12-1 and 12-2 for legend and location.

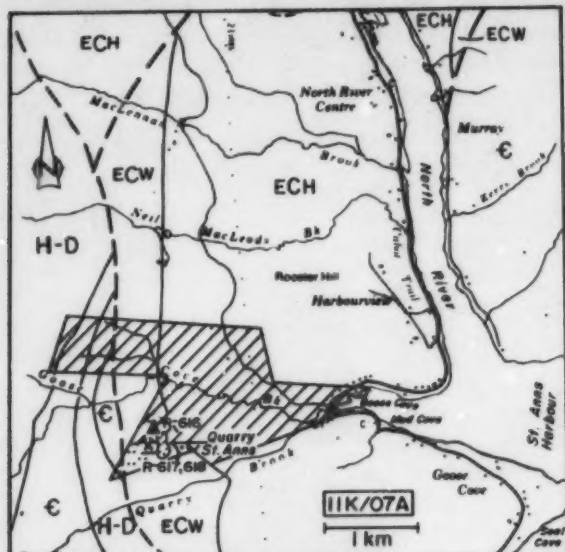
Regional mapping by Kelley (1968b) has this locale underlain by undivided Windsor Group rocks in fault contact with Devonian or earlier igneous rocks to the northwest.

This occurrence is of geological interest only because there is limited areal extent of the Windsor material to be found above the waters of the Great Bras d'Or.



**QUARRY ST. ANNS (0069)**  
 NTS 11K/07A  
 UTM 681250 E 5125500 N

The Quarry St. Anns area is located 20 km northeast of the Village of Baddeck, Victoria County (Fig. 12-23). It



Geology modified after Kelley, 1960; Barr et al., 1987

- ▨ National Gypsum (loose)
- ⋯ National Gypsum (fee simple)

Figure 12-23. Location and geology of the Quarry St. Anns occurrence area. See Figures 12-1 and 12-2 for legend and location.

includes the site of a turn of the century gypsum quarry (origin of the place name). Historical records (Nova Scotia Department of Mines, Annual Reports, 1885-1917) reported that gypsum was produced from the site at Quarry St. Anns from at least 1884-1916. Unfortunately, reports of individual quarry activities during this period are sporadic and production figures are available for only twelve of those years.

The Victoria Gypsum Company of Baddeck (later Victoria Gypsum, Mining and Manufacturing Company Limited) produced stone from an open-pit until 1916, at which time it was reported that underground operations were to commence at the site. Nova Scotia Department of Mines, Annual Reports after 1916 do not mention the Quarry St. Anns site. Although all reports stated that gypsum was produced here, one Annual Report made reference to the sale of land plaster which may have referred to anhydrite. Of the years reported, maximum production was in 1914 with a total of 36 304 t produced (Nova Scotia Department of Mines, Annual Report, 1915). Shipments were made out of St. Anns Bay via

either Munro Point or Seymour Point (it is unclear which was used). Some of the gypsum rights and property at Quarry St. Anns are presently held by the National Gypsum Company who bought portions of the property once held by the Victoria Gypsum Company.

Kelley (1960) and more recently Barr et al. (1987) mapped the area as being underlain by undivided Windsor Group rocks. These are underlain to the east by clastics of the Horton Group and in fault contact with older igneous and metamorphic units to the west. Although records of drillholes are unavailable for the area, the massive sulphate units exposed in the quarry area appear to belong to the Cycle 1 (A Subzone) of the Windsor Group.

The quarry is approximately hour glass shaped, 200 m long and elongate north-south. It has faces up to 15 m in height, the top halves of which are fine grained, white gypsum. A small lake lies 100 m north of the old workings and the heads and karst appear to end 300 m south of the quarry.

In general the gypsum and anhydrite at Quarry St. Anns appear to be a block of material which remains intact between the areas of dissolution along the courses of Goose Cove Brook to the north and Quarry Brook to the south. Airphoto interpretation (not yet ground checked) indicates there may be a second block of the basal sulphate unit located north of Goose Cove Brook.

Although the areal extent of the basal Windsor at Quarry St. Anns appears to be quite limited, some diamond drilling could be undertaken to further evaluate the site's economic potential. The reference to the development of an underground mine in 1916 would suggest possible gypsum horizons lying beneath the anhydrite seen at surface and these should be investigated. Major development at the Quarry St. Anns site appears to be unlikely.

**ST. ANNS HARBOUR (0077)**  
 NTS 11K/02D  
 UTM 684000 E 5120000 N

Several individual occurrences can be found in the St. Anns Harbour area (Fig. 12-24). They extend from Mill Cove Brook in the north, along the western side of North Gut, and the western side of South Gut southwest towards Glen Tosh. The area is 15 km northeast of the Village of Baddeck, Victoria County.

All of the occurrences consist of massive, fine grained, white gypsum overlying massive, light blue anhydrite which appears to belong to Cycle 1

(A Subzone) of the Windsor Group. These occurrences are unusual in that in some cases anhydrite and anhydritic gypsum can be found at the surface.

Regional geological mapping by Kelley (1968b) and Barr et al. (1987) established that the area is underlain by a northeasterly trending trough of Carboniferous material. This is flanked to the southeast and northwest by older igneous and metamorphic basement rocks. The trough appears to be a synform having older Horton Group clastics underneath the Windsor Group marine sedimentary rocks (Fig. 12-24). Detailed stratigraphic

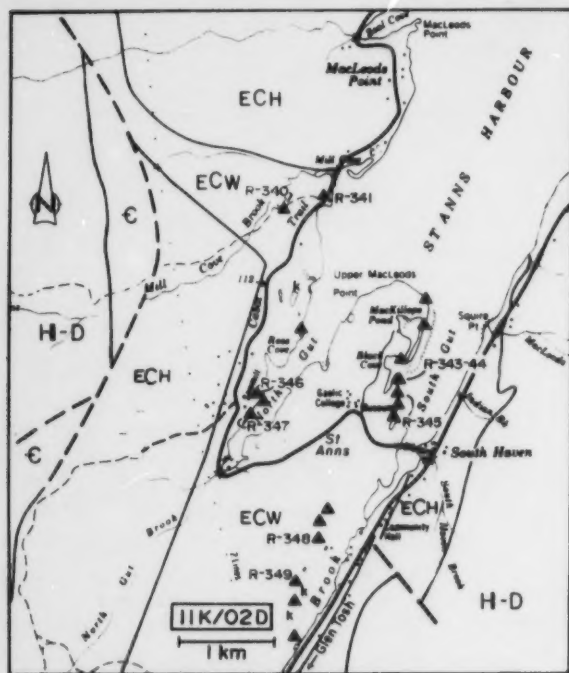


Figure 12-24. Location and geology of the St. Ann's Harbour occurrence area. See Figures 12-1 and 12-2 for legend and location.

interpretation has not been attempted in the area. Hydration, for the most part, appears to be shallow over much of the area and therefore there is little potential for significant gypsum. The presence of anhydrite near surface does suggest that the area might be prospective for deposits of high purity anhydrite of the type used in gateside packing in coal mines.

WASHABUCK BRIDGE (0080)  
NTS 11K/02B  
UTM 663800 E 5097500 N

**The Washabuck Bridge occurrence encompasses an area from Hazeldale, (Fig. 12-25) south to the Washabuck River, east to Cranberry Point, north to MacInnis Cove**

and west to MacIvers Point. The available information consists of several outcrops, some karst topography and four diamond-drill holes.

Regional geological mapping by Kelley (1968b) showed the area as underlain by undivided Windsor Group sedimentary rocks. These units are underlain to the southeast by Horton Group clastics and are bounded to the north and west by the Horton Group; however, this contact lies beneath St. Patricks Channel and is undefined.

In 1974 St. Joseph Explorations Ltd. drilled a total of 481.74 m in three holes in this area (McCulloch, 1974c). Hole 141-1 (T.D. 145 m) at Hazeldale encountered an interbedded sequence of sulphates, carbonates and clastics which is similar to the quarry section described at Little Narrows Gypsum's Magazine Quarry (0087) by Holleman (1976). No stratigraphic correlation was attempted by St. Joseph at the time of drilling, however the section probably represents a somewhat disturbed section of Cycle 2 (B Subzone). The two other holes are located to the southeast towards the Windsor-Horton contact. Hole 141-2 appears to have been collared and stopped in the basal sulphate passing

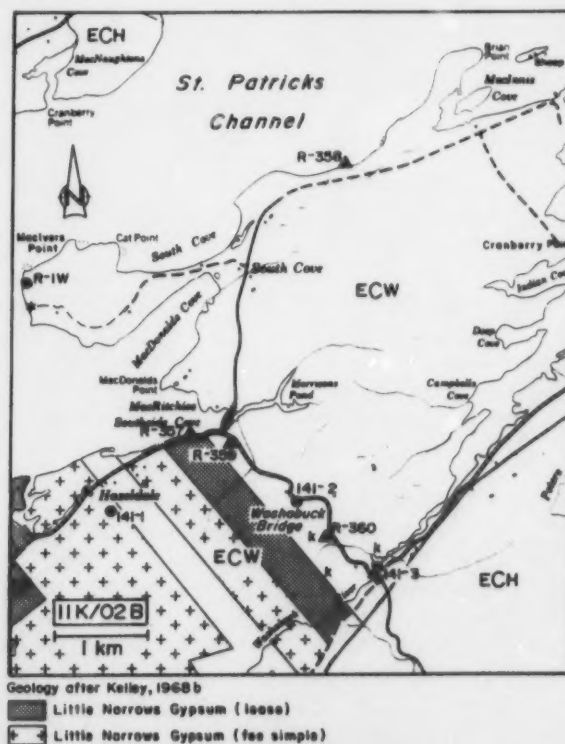


**Figure 12-25. Location and geology of the Washabuck Bridge occurrence area. See Figures 12-1 and 12-2 for legend and location.**

through 35.51 m of overburden and then 128.47 m of gypsum containing minor amounts of calcareous siltstone and mudstone. Nearest the contact, hole 141-3 encountered 8.53 m of overburden, 25.3 m of what was described as unconsolidated siltstone, 84.43 m of gypsum, a partially filled cavity and 10.36 m of basal limestone before entering what appears to be a Horton Group sandstone. In 1981 Chevron Standard Limited drilled a potash exploration hole at MacIvers Point 2000 m to the northwest of hole 141-1 (Dekker, 1982). This hole, designated R-1W, reached a total depth of 1185 m. The company believed that they had collared in the Cycle 3 (C Subzone) of the Windsor Group, passed through a complex, folded sequence of clastics, carbonates, sulphates and salt before being stopped in basal anhydrite (Dekker, 1982).

Although the actual drill core has not yet been inspected the Washabuck Bridge occurrence is an extremely interesting one. The area adjacent to the Horton-Windsor contact, where holes 141-2 and 141-3 were drilled, appears to be deeply hydrated and may host

significant volumes of economic gypsum. Northwestward, towards the centre of this Carboniferous basin, the geological section rapidly becomes more complex and therefore less amenable to large scale mining of gypsum.

Currently, producing companies hold much of this area in fee simple or under rights agreements, however it appears that those lands east of the secondary road at Washabuck Bridge are not presently held. Although there is only limited information on this area it should be considered very prospective for further drilling to confirm the deep hydration indicated in the available drillholes.

This area has a long history of gypsum mining, is sparsely populated and most of the immediate vicinity is covered by scrub bush. St. Patricks Channel is presently used by Little Narrows Gypsum to ship its stone out of the Bras d'Or Lakes to market, therefore shipping facilities could probably be made within 2-4 km of a quarry site.





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**APPENDIX 1. LIST OF OCCURRENCES ORDERED BY NTS**



## APPENDIX 1. LIST OF OCCURRENCES ORDERED BY NTS

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NORTHFIELD, HANTS COUNTY .....	95
STIRLING BROOK, HANTS COUNTY .....	100

### 11E/06A

OTTER BROOK, COLCHESTER COUNTY .....	42
SMITHFIELD, COLCHESTER COUNTY .....	45

### 11E/06B

BEAVER BROOK, COLCHESTER COUNTY .....	34
HILDEN, COLCHESTER COUNTY .....	39
PRINCEPORT, COLCHESTER COUNTY .....	45
SOUTH MAITLAND, HANTS COUNTY .....	99
UPPER BROOKFIELD, COLCHESTER COUNTY .....	48



**11E/07B**

GLENBERVIE, COLCHESTER COUNTY ..... 38

**11E/07C**

EASTVILLE, COLCHESTER COUNTY ..... 37

**11E/07D**

BRIDGEVILLE, PICTOU COUNTY ..... 134

FORBES LAKE, PICTOU COUNTY ..... 134

LORNE, PICTOU COUNTY ..... 135

**11E/09A**

ADDINGTON FORKS, ANTIGONISH COUNTY ..... 18

ASHDALE, ANTIGONISH COUNTY ..... 18

BRIERLY BROOK, ANTIGONISH COUNTY ..... 20

OHIO, ANTIGONISH COUNTY ..... 24

**11E/09D**

BIG MARSH, ANTIGONISH COUNTY ..... 19

RIGHTS RIVER, ANTIGONISH COUNTY ..... 25

SYLVAN VALLEY, ANTIGONISH COUNTY ..... 27

**11E/10B**

LIMEROCK, PICTOU COUNTY ..... 135

**11E/12C**

HANSFORD, CUMBERLAND COUNTY ..... 53

OXFORD, CUMBERLAND COUNTY ..... 56

**11E/13A**

CANFIELDS CREEK, CUMBERLAND COUNTY ..... 52

PUGWASH, CUMBERLAND COUNTY ..... 57

**11E/13B**

BECKWITH, CUMBERLAND COUNTY ..... 52

PURDY BROOK, CUMBERLAND COUNTY ..... 58

ROSLIN, CUMBERLAND COUNTY ..... 58

**11E/14B**

LAZY BAY, CUMBERLAND COUNTY ..... 53

MALAGASH, CUMBERLAND COUNTY ..... 54

**11F/10D**

HAY COVE, RICHMOND COUNTY ..... 139

LIZZIES LAKE, RICHMOND COUNTY ..... 140

**11F/11A**

DOREYS POINT, RICHMOND COUNTY ..... 138

LENNOX, RICHMOND COUNTY ..... 139

**11F/11B**

MULGRAVE, GUYSBOROUGH COUNTY ..... 61

PORT RICHMOND, RICHMOND COUNTY ..... 140

**11F/11C**

MACINTYRE LAKE, INVERNESS COUNTY ..... 120

PORT HASTINGS, INVERNESS COUNTY ..... 125

SUGAR CAMP, INVERNESS COUNTY ..... 129

**11F/11D**

DUNDEE, RICHMOND COUNTY ..... 138

**11F/12A**

MONASTERY, ANTIGONISH COUNTY ..... 22

**11F/12B**

BEECH HILL, ANTIGONISH COUNTY ..... 19

POMQUET RIVER, ANTIGONISH COUNTY ..... 25

**11F/12C**

CRYSTAL CLIFFS, ANTIGONISH COUNTY ..... 21

HARBOUR CENTRE, ANTIGONISH COUNTY ..... 21

LANARK, ANTIGONISH COUNTY ..... 22

MONKS HEAD, ANTIGONISH COUNTY ..... 23

POMQUET HARBOUR, ANTIGONISH COUNTY ..... 24

RIGHTS RIVER, ANTIGONISH COUNTY ..... 25

SOUTHSIDE ANTIGONISH HARBOUR,

ANTIGONISH COUNTY ..... 26

WILLIAMS POINT, ANTIGONISH COUNTY ..... 28

**11F/13D**

LITTLE JUDIQUE HARBOUR, INVERNESS COUNTY. 119

**11F/14A**

BIG BROOK, INVERNESS COUNTY ..... 112

MACLEANS COVE, INVERNESS COUNTY ..... 121

RIVER DENYS, INVERNESS COUNTY ..... 127

**11F/14B**

KINGSVILLE, INVERNESS COUNTY ..... 118

MELFORD, INVERNESS COUNTY ..... 124

**11F/14C**

CAPTAINS BROOK, INVERNESS COUNTY ..... 114

RIVER CENTRE, INVERNESS COUNTY ..... 127

UPPER RIVER DENYS, INVERNESS COUNTY ..... 131

**11F/14D**

ALBA, INVERNESS COUNTY ..... 111

GLEN BROOK, INVERNESS COUNTY ..... 115

ORANGEDALE, INVERNESS COUNTY .....	125
STONE POINT, INVERNESS COUNTY .....	129

**11F/15A**

LOCH LOMOND, CAPE BRETON COUNTY .....	30
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**11F/15C**

IONA, VICTORIA COUNTY .....	146
JAMESVILLE, VICTORIA COUNTY .....	147
JUBILEE, VICTORIA COUNTY .....	148
LITTLE NARROWS, VICTORIA COUNTY .....	150
MALAGAWATCH, INVERNESS COUNTY .....	122
OTTAWA BROOK, VICTORIA COUNTY .....	154

**11K/01B**

MEADOWS ROAD, CAPE BRETON COUNTY .....	31
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**11K/01C**

LEITCHES CREEK, CAPE BRETON COUNTY .....	30
REAR BALLS CREEK, CAPE BRETON COUNTY .....	32
SAUNDERS COVE, CAPE BRETON COUNTY .....	32

**11K/02B**

HUNTERS MOUNTAIN, VICTORIA COUNTY .....	145
LOWER WASHABUCK, VICTORIA COUNTY .....	152
PONYS POINT, VICTORIA COUNTY .....	156
WASHABUCK BRIDGE, VICTORIA COUNTY .....	158

**11K/02C**

FORKS BADDECK, VICTORIA COUNTY .....	144
MIDDLE RIVER, VICTORIA COUNTY .....	153
PETERS BROOK, VICTORIA COUNTY .....	156

**11K/02D**

BIG HILL, VICTORIA COUNTY .....	142
BOULARDERIE CENTRE, VICTORIA COUNTY .....	142
ISLAND POINT, VICTORIA COUNTY .....	147
LONG HILL, VICTORIA COUNTY .....	151
ST. ANNS HARBOUR, VICTORIA COUNTY .....	157

**11K/03B**

GLENDYER STATION, INVERNESS COUNTY .....	116
GREEN POINT, INVERNESS COUNTY .....	117
HAYS RIVER, INVERNESS COUNTY .....	117
MABOU HARBOUR MOUTH, INVERNESS COUNTY .....	119
MABOU STATION, INVERNESS COUNTY .....	120
SOUTHWEST MABOU, INVERNESS COUNTY .....	128
WEST MABOU HARBOUR, INVERNESS COUNTY .....	131

**11K/03C**

FINLAY POINT, INVERNESS COUNTY .....	115
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**11K/03D**

UPPER MARGAREE, INVERNESS COUNTY .....	130
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**11K/04A**

PORT HOOD ISLAND, INVERNESS COUNTY .....	126
WEST MABOU HARBOUR, INVERNESS COUNTY .....	131

**11K/06A**

MARGAREE CENTRE, INVERNESS COUNTY .....	122
MARGAREE FORKS, INVERNESS COUNTY .....	123

**11K/06B**

BROAD COVE, INVERNESS COUNTY .....	113
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**11K/06D**

MARGAREE HARBOUR, INVERNESS COUNTY .....	123
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**11K/07A**

QUARRY ST. ANNS, VICTORIA COUNTY .....	157
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**11K/07C**

KINGROSS, INVERNESS COUNTY .....	118
PORTREE, INVERNESS COUNTY .....	126

**11K/08B**

KELLYS COVE, VICTORIA COUNTY .....	149
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**11K/08C**

FRENCH RIVER, VICTORIA COUNTY .....	144
NORTH SHORE, VICTORIA COUNTY .....	154

**11K/09C**

INGONISH BEACH, VICTORIA COUNTY .....	145
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**11K/10C**

CHÉTICAMP, INVERNESS COUNTY .....	114
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**11K/11A**

GRAND ÉTANG, INVERNESS COUNTY .....	116
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**11K/16C**

DINGWALL, VICTORIA COUNTY .....	143
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**21A/16D**

GYPSUM MINES, HANTS COUNTY .....	84
MARTOCK, HANTS COUNTY .....	90
ST. CROIX, HANTS COUNTY .....	98
THREE MILE PLAINS, HANTS COUNTY .....	102
UPPER FALMOUTH, HANTS COUNTY .....	104
WENTWORTH CREEK, HANTS COUNTY .....	108
WINDSOR, HANTS COUNTY .....	109

**21H/01A**

AVONDALE, HANTS COUNTY .....	81
FALMOUTH, HANTS COUNTY .....	83
LOWER BURLINGTON, HANTS COUNTY .....	88
MANTUA, HANTS COUNTY .....	89
MILLER CREEK, HANTS COUNTY .....	91
MOUNT DENSON, HANTS COUNTY .....	92
SUMMERVILLE, HANTS COUNTY .....	101

**21H/01D**

CHEVERIE, HANTS COUNTY .....	82
KEMPT SHORE, HANTS COUNTY .....	86
PEMBROKE, HANTS COUNTY .....	96

**21H/09D**

SPRINGHILL, CUMBERLAND COUNTY .....	59
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**21H/16A**

NAPPAN, CUMBERLAND COUNTY .....	55
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**21H/16B**

LOWER MACCAN, CUMBERLAND COUNTY .....	54
NAPPAN, CUMBERLAND COUNTY .....	55

**APPENDIX 2. LIST OF OCCURRENCES ORDERED BY REFERENCE NUMBER**





## APPENDIX 2. LIST OF OCCURRENCES ORDERED BY REFERENCE NUMBER

OCCURRENCE	LOCATION	COUNTY	PAGE
0001	MEADOWS ROAD	CAPE BRETON	31
0002	BOULARDERIE CENTRE	VICTORIA	142
0003	SAUNDERS COVE	CAPE BRETON	32
0004	HAY COVE	RICHMOND	139
0005	MOUNT DENSON	HANTS	92
0006	WINDSOR	HANTS	109
0007	UPPER FALMOUTH	HANTS	104
0008	MARTOCK	HANTS	90
0009	THREE MILE PLAINS	HANTS	102
0010	LENNOX	RICHMOND	139
0011	DOREYS POINT	RICHMOND	138
0012	LITTLE JUDIQUE HARBOUR	INVERNESS	119
0013	GLENDYER STATION	INVERNESS	116
0014	DUNDEE	RICHMOND	138
0015	HAYS RIVER	INVERNESS	117
0016	MACINTYRE LAKE	INVERNESS	120
0017	FINLAY POINT	INVERNESS	115
0018	WEST MABOU HARBOUR	INVERNESS	131
0019	UPPER MARGAREE	INVERNESS	130
0020	MABOU STATION	INVERNESS	120
0021	GREEN POINT	INVERNESS	117
0022	SOUTHWEST MABOU	INVERNESS	128
0023	MARGAREE FORKS	INVERNESS	123
0024	GYPSUM MINES	HANTS	84
0025	ST. CROIX	HANTS	98
0026	WOODVILLE	HANTS	110
0027	LOCH LOMOND	CAPE BRETON	30
0028	LEITCHES CREEK	CAPE BRETON	30
0029	REAR BALLS CREEK	CAPE BRETON	32
0030	LIZZIES LAKE	RICHMOND	140
0031	ALBA	INVERNESS	111
0032	STONEY POINT	INVERNESS	129
0033	ORANGEDALE	INVERNESS	125
0034	MACLEANS COVE	INVERNESS	121
0035	MALAGAWATCH	INVERNESS	122
0036	UPPER RIVER DENYS	INVERNESS	131
0037	MELFORD	INVERNESS	124
0038	RIVER DENYS	INVERNESS	127
0039	BIG BROOK	INVERNESS	112
0040	KINGSVILLE	INVERNESS	118
0041	SUGAR CAMP	INVERNESS	129
0042	PORT RICHMOND	RICHMOND	140
0043	RIVER CENTRE	INVERNESS	127
0044	MABOU HARBOUR MOUTH	INVERNESS	119
0045	MARGAREE HARBOUR	INVERNESS	123
0046	BROAD COVE	INVERNESS	113
0047	CHETICAMP	INVERNESS	114
0048	DINGWALL	VICTORIA	143
0049	KELLYS COVE	VICTORIA	149
0050	ISLAND POINT	VICTORIA	147

0051	CHEVERIE	HANTS	82
0052	KEMPT SHORE	HANTS	86
0053	SUMMERVILLE	HANTS	101
0054	LOWER BURLINGTON	HANTS	88
0055	LATTIES BROOK	HANTS	87
0056	MCKAY SECTION	HANTS	90
0057	MANTUA	HANTS	89
0058	AVONDALE	HANTS	81
0059	FALMOUTH	HANTS	83
0060	TENNYCAPE	HANTS	101
0061	GLEN BROOK	HANTS	83
0062	RIVERSIDE CORNER	HANTS	97
0063	HAYES CAVE	HANTS	85
0064	NORTHFIELD	HANTS	95
0065	UNIACKE BROOK	HANTS	104
0066	WHITTIER BROOK	HANTS	109
0067	CAPTAINS BROOK	INVERNESS	114
0068	PORTREE	INVERNESS	126
0069	KINGROSS	INVERNESS	118
0070	MARGAREE CENTRE	INVERNESS	122
0071	GRAND ETANG	INVERNESS	116
0072	FORKS BADDECK	VICTORIA	144
0073	PETERS BROOK	VICTORIA	156
0074	MIDDLE RIVER	VICTORIA	153
0075	INGONISH BEACH	VICTORIA	145
0076	NORTH SHORE	VICTORIA	154
0077	ST. ANNS HARBOUR	VICTORIA	157
0078	BIG HILL	VICTORIA	142
0079	HUNTERS MOUNTAIN	VICTORIA	145
0080	WASHABUCK BRIDGE	VICTORIA	158
0081	LOWER WASHABUCK	VICTORIA	152
0082	PONYS POINT	VICTORIA	156
0083	OTTAWA BROOK	VICTORIA	154
0084	IONA	VICTORIA	146
0085	JAMESVILLE	VICTORIA	147
0086	JUBILEE	VICTORIA	148
0087	LITTLE NARROWS	VICTORIA	150
0088	FRENCH RIVER	VICTORIA	144
0089	QUARRY ST. ANNS	VICTORIA	157
0090	PORT HOOD ISLAND	INVERNESS	126
0091	GLEN BROOK	INVERNESS	115
0092	PORT HASTINGS	INVERNESS	125
0093	MONKS HEAD	ANTIGONISH	23
0094	SOUTHSIDE ANTIGONISH HARBOUR	ANTIGONISH	26
0095	WILLIAMS POINT	ANTIGONISH	28
0096	POMQUET HARBOUR	ANTIGONISH	24
0097	POMQUET RIVER	ANTIGONISH	25
0098	BEECH HILL	ANTIGONISH	19
0099	ASHDALE	ANTIGONISH	18
0100	ADDINGTON FORKS	ANTIGONISH	18
0101	BRIERLY BROOK	ANTIGONISH	20
0102	SYLVAN VALLEY	ANTIGONISH	27
0103	RIGHTS RIVER	ANTIGONISH	25
0104	CRYSTAL CLIFFS	ANTIGONISH	21
0105	HARBOUR CENTRE	ANTIGONISH	21

0106	LANARK	ANTIGONISH	22
0107	BIG MARSH	ANTIGONISH	19
0108	MONASTERY	ANTIGONISH	22
0109	OHIO	ANTIGONISH	24
0110	MULGRAVE	GUYSBOROUGH	61
0111	BRIDGEVILLE	PICTOU	134
0112	FORBES LAKE	PICTOU	134
0113	LORNE	PICTOU	135
0114	LIMEROCK	PICTOU	135
0115	EASTVILLE	COLCHESTER	37
0116	GLENBERVIE	COLCHESTER	38
0117	NEWTON MILLS	COLCHESTER	41
0118	STEWIACKE	COLCHESTER	47
0119	GLENMORE	HALIFAX	73
0120	BRENTWOOD	COLCHESTER	34
0121	BROOKFIELD	COLCHESTER	35
0122	LANESVILLE	COLCHESTER	39
0123	PINE GROVE	COLCHESTER	43
0124	COLDSTREAM	COLCHESTER	36
0125	ANNAND BROOK	HALIFAX	64
0126	ANTRIM	HALIFAX	64
0127	COOKS BROOK	HALIFAX	68
0128	CHASWOOD	HALIFAX	67
0129	BLACK BROOK	HALIFAX	65
0130	MIDDLE MUSQUODOBOIT	HALIFAX	75
0131	ELDERBANK	HALIFAX	72
0132	LAKE EGMONT	HALIFAX	74
0133	CARROLLS CORNER	HALIFAX	66
0134	EAST MILFORD	HALIFAX	71
0135	DUTCH SETTLEMENT	HALIFAX	69
0136	ELMSDALE	HANTS	82
0137	HORNE SETTLEMENT	HANTS	86
0138	TULLOCK BROOK	HANTS	103
0139	NINE MILE RIVER	HANTS	93
0140	HARDWOOD LANDS	HANTS	84
0141	SHUBENACADIE	HANTS	98
0142	MACPHEES CORNER	HANTS	88
0143	NORTH SALEM	HANTS	95
0144	ADMIRAL ROCK	HANTS	80
0145	URBANIA	HANTS	105
0146	SOUTH MAITLAND	HANTS	99
0147	PRINCEPORT	COLCHESTER	45
0148	BEAVER BROOK	COLCHESTER	34
0149	HILDEN	COLCHESTER	39
0150	PLEASANT VALLEY	COLCHESTER	44
0151	UPPER BROOKFIELD	COLCHESTER	48
0152	MIDDLE STEWIACKE	COLCHESTER	41
0153	CAMDEN ROAD	COLCHESTER	36
0154	SMITHFIELD	COLCHESTER	45
0155	OTTER BROOK	COLCHESTER	42
0156	STEWIACKE CROSS ROADS	COLCHESTER	47
0157	MEADOWVALE	COLCHESTER	40
0158	SOUTH BRANCH	COLCHESTER	46
0159	ELMSVALE	HALIFAX	73
0160	DEDICATION LAKE	HALIFAX	69



0161	UPPER MUSQUODOBOIT	HALIFAX	77
0162	BROOKVALE	HALIFAX	66
0163	MURCHYVILLE	HALIFAX	76
0164	MEAGHERS GRANT	HALIFAX	75
0165	WYSES CORNER	HALIFAX	78
0166	MALAGASH	CUMBERLAND	54
0167	LAZY BAY	CUMBERLAND	53
0168	PUGWASH	CUMBERLAND	57
0169	CANFIELDS CREEK	CUMBERLAND	52
0170	ROSLIN	CUMBERLAND	58
0171	BECKWITH	CUMBERLAND	52
0172	PURDY BROOK	CUMBERLAND	58
0173	HANSFORD	CUMBERLAND	53
0174	OXFORD	CUMBERLAND	56
0175	SPRINGHILL	CUMBERLAND	59
0176	LOWER MACCAN	CUMBERLAND	54
0177	NAPPAN	CUMBERLAND	55
0178	NOEL LAKE	HANTS	94
0179	WALTON	HANTS	106
0180	PEMBROKE	HANTS	96
0181	WALTON RIVER	HANTS	107
0182	WENTWORTH CREEK	HANTS	108
0183	MILLER CREEK	HANTS	91
0184	STANLEY	HANTS	100
0185	STIRLING BROOK	HANTS	100
0186	LONG HILL	VICTORIA	151

**APPENDIX 3.**

**ANALYTICAL DATA FOR HAND SPECIMENS AND DRILL CORE SAMPLES**

**PERTAINING TO INDIVIDUAL OCCURRENCES**

**BY REFERENCE NUMBER**

**(MINERALS ENGINEERING CENTRE, TECHNICAL UNIVERSITY OF NOVA SCOTIA)**









## Occurrence 0002

GpAnR-9 0.72 19.84 45.17 94.86 1.78 0.006 33.05 2.52 0.82 0.20 0.04 0.30 <50 52 260

## Occurrence 0003

GpAnR-10 0.07 18.27 41.59 87.35 1.61 0.005 33.82 8.36 0.27 0.12 0.04 1.32 <50 66 730  
 GpAnR-11 0.04 20.24 45.90 96.97 1.51 0.003 33.31 2.07 0.27 <0.10 0.03 0.03 <50 43 870  
 GpAnR-12 0.04 19.84 44.40 94.85 0.47 0.003 34.15 5.44 0.42 0.12 0.03 0.55 55 86 1500  
 GpAnR-13 1.31 7.10 15.84 33.94 0.08 0.022 12.44 2.40 50.54 8.36 2.06 1.37 85 300 100  
 GpAnR-15 0.06 19.90 44.91 95.14 1.11 0.005 32.47 1.80 1.21 0.12 0.06 0.28 65 45 670  
 GpAnR-16 <0.01 20.28 46.11 96.96 1.71 0.007 32.47 0.30 0.70 0.12 0.04 0.04 <50 10 400  
 GpAnR-17 0.10 20.15 46.19 96.34 2.34 0.008 32.47 0.20 0.54 0.12 0.03 0.03 <50 5 350

## Occurrence 0004

GpAnR-18 0.43 19.27 43.82 92.13 1.64 0.011 34.49 6.77 0.67 0.12 0.03 0.09 175 6 730  
 GpAnR-19 1.03 20.12 45.09 96.19 0.58 0.008 31.63 0.10 0.21 <0.10 0.02 0.04 <50 20 590  
 GpAnR-44 0.05 20.04 44.92 95.76 0.60 0.013 32.64 2.09 0.70 <0.10 0.02 0.04 <50 5 560  
 GpAnR-45 0.05 18.58 42.08 88.79 1.29 0.008 33.65 7.44 0.87 <0.10 0.02 0.09 <50 13 980  
 GpAnR-46 0.09 19.39 43.90 92.66 1.32 0.004 33.40 4.72 0.62 <0.10 0.01 0.05 <50 25 570  
 GpAnR-47 <0.01 18.13 41.26 86.63 1.60 0.015 34.49 9.97 1.15 0.12 0.03 0.13 <50 30 1400  
 GpAnR-48 0.01 18.14 41.72 86.68 2.34 0.008 30.72 2.67 3.97 0.85 0.13 1.32 75 40 830  
 GpAnR-49 <0.01 20.38 46.20 97.39 1.49 0.015 32.47 0.19 0.62 <0.10 0.01 0.04 <50 5 330  
 GpAnR-50 <0.01 20.07 46.10 95.91 2.49 0.036 32.81 0.92 0.91 0.12 0.02 0.11 <50 4 300

## Occurrence 0005

GpAnR-20 0.07 14.10 48.85 67.41 29.74 0.008 34.66 0.79 0.40 <0.10 0.03 0.10 <50 10 600  
 GpAnR-24 1.14 19.63 45.49 93.85 3.11 0.001 33.06 2.13 1.40 <0.10 0.04 0.05 <50 12 870  
 GpAnR-1512 <0.01 20.62 45.92 98.52 0.11 0.007  
 GpAnR-1513 <0.01 20.76 46.68 99.19 0.87 0.006  
 GpAnR-1514 <0.01 20.89 46.74 99.81 0.48 0.005  
 GpAnR-1515 <0.01 20.80 46.67 99.38 0.70 0.006  
 GpAnR-1516 <0.01 20.91 46.89 99.91 0.66 0.004  
 GpAnR-1517 <0.01 19.60 47.88 93.65 7.30 0.005  
 GpAnR-1518 <0.01 20.72 46.56 99.00 0.82 0.005  
 GpAnR-1519 <0.01 17.78 48.85 84.95 15.83 0.006  
 GpAnR-1520 <0.01 11.27 52.31 53.85 46.33 0.002  
 GpAnR-1521 0.01 9.57 53.40 45.73 54.61 0.004  
 GpAnR-1522 <0.01 19.75 47.22 94.37 5.61 0.005  
 GpAnR-1523 <0.01 17.19 47.00 82.13 14.91 0.008  
 GpAnR-1524 <0.01 16.75 47.40 80.03 17.26 0.005  
 GpAnR-1525 <0.01 6.56 55.28 31.34 69.19 0.006

Sample Number	Moisture %	Comb H ₂ O %	SO ₃ %	Gypsum %	Anhydrite %	NaCl %	CaO %	CaCO ₃ %	SiO ₂ %	Al ₂ O ₃ %	K ₂ O %	MgO %	B ppm	Ba ppm	Sr ppm
GpAnR-1526	0.08	19.30	47.38	92.22	7.58	0.005									
GpAnR-1527	0.09	15.44	48.99	73.77	24.92	0.008									
GpAnR-1528	0.09	15.71	49.12	75.06	24.12	0.010									
GpAnR-1529	0.09	20.41	46.11	97.52	1.22	0.009									
GpAnR-1530	0.09	20.45	46.52	97.71	1.77	0.015									
GpAnR-1531	0.06	18.08	47.73	86.39	12.79	0.009									
GpAnR-1532	0.01	20.58	46.24	98.33	0.80	0.006									
GpAnR-1533	0.10	20.28	45.64	96.90	0.92	0.008									
GpAnR-1534	0.01	2.15	56.86	10.27	88.55	0.010									
GpAnR-1535	0.03	0.47	57.77	2.25	96.46	0.011									
GpAnR-1536	0.01	0.44	57.92	2.10	96.82	0.014									
GpAnR-1537	0.01	0.34	57.11	1.63	95.82	0.009									
GpAnR-1538	0.04	0.84	57.42	4.01	94.46	0.008									
GpAnR-1539	0.03	0.64	57.78	3.06	95.83	0.012									
GpAnR-1540	0.05	0.54	57.59	2.58	95.88	0.016									
GpAnR-1541	0.04	0.59	57.77	2.82	96.00	0.009									
GpAnR-1542	0.02	0.55	57.39	2.63	95.51	0.006									
GpAnR-1543	0.01	0.47	57.43	2.25	96.05	0.006									
GpAnR-1544	0.01	0.48	57.92	2.29	96.67	0.007									
GpAnR-1545	0.01	0.42	57.38	2.01	95.98	0.009									
GpAnR-1546	<0.01	1.32	56.02	6.31	90.27	0.013									
GpAnR-1547	<0.01	0.67	58.05	3.20	96.18	0.012									
GpAnR-1548	<0.01	0.86	57.09	4.11	93.82	0.008									
GpAnR-1549	<0.01	0.64	57.19	3.06	94.83	0.010									
GpAnR-1550	<0.01	0.70	57.13	3.35	94.50	0.010									
GpAnR-1551	<0.01	0.53	57.88	2.53	96.42	0.012									
GpAnR-1552	<0.01	0.90	57.24	4.30	93.93	0.011									
GpAnR-1553	<0.01	0.67	56.83	3.20	94.10	0.011									
GpAnR-28	0.11	1.49	56.25	7.12	90.01	0.063	39.70	0.53	0.33	<0.10	0.02	0.44	75	70	3000
GpAnR-29	0.15	1.07	57.47	5.11	93.67	0.057	40.50	0.44	0.38	<0.10	0.02	0.15	85	77	5000
GpAnR-30	0.04	1.38	57.73	6.59	92.94	0.035	40.69	0.44	0.51	0.10	0.02	0.05	100	5	1100
GpAnR-31	<0.01	19.44	46.71	92.94	5.90	0.015	33.42	1.25	0.57	0.10	0.02	0.03	55	32	820
GpAnR-32	<0.01	19.74	45.45	94.38	2.68	0.060	31.97	0.23	1.13	0.15	0.03	0.31	55	7	520
GpAnR-33	0.42	19.73	45.46	94.28	2.69	0.151	31.91	1.90	1.14	0.12	0.05	0.39	55	47	580
GpAnR-34	0.06	21.13	46.47	96.24	2.89	0.031	32.63	0.14	1.08	0.12	0.05	0.17	<50	30	620
GpAnR-35	<0.01	0.98	57.49	4.68	94.04	0.039	40.71	0.24	0.48	0.10	0.01	0.03	120	5	870
GpAnR-36	<0.01	0.80	52.59	3.82	86.39	0.037	41.83	8.91	0.78	0.12	0.02	0.17	65	13	1200







GpAnR-1562	0.05	0.69	58.14	3.30	96.25	0.023
GpAnR-1563	0.04	0.51	57.70	2.44	96.19	0.064
GpAnR-1564	0.06	0.47	56.97	2.25	95.09	0.011
GpAnR-1565	0.03	0.46	54.40	2.20	90.76	0.015
GpAnR-1566	0.11	1.53	47.35	7.31	74.73	0.016
GpAnR-1567	0.02	0.65	57.68	3.11	95.62	0.010
GpAnR-1568	0.08	0.65	58.12	3.11	96.37	0.010
GpAnR-1569	0.04	0.38	58.11	1.82	97.37	0.011
GpAnR-1570	0.11	0.40	57.43	1.91	96.14	0.008
GpAnR-1571	0.05	0.35	57.17	1.67	95.89	0.007
GpAnR-1572	0.05	0.31	58.11	1.48	97.66	0.008
GpAnR-1573	0.01	0.24	58.36	1.15	98.33	0.008
GpAnR-1574	0.06	0.31	58.25	1.48	97.88	0.007
GpAnR-1575	0.04	0.43	58.50	2.06	97.85	0.010
GpAnR-1576	0.04	0.48	58.38	2.29	97.45	0.010
GpAnR-1577	0.06	0.34	58.43	1.63	98.07	0.008
GpAnR-1578	0.06	0.68	58.17	3.25	96.34	0.009
GpAnR-1579	<0.01	0.32	58.15	1.53	97.67	0.010
GpAnR-1580	<0.01	0.99	57.49	4.73	94.01	0.009
GpAnR-1581	0.01	0.44	58.45	2.10	97.73	0.008
GpAnR-1582	0.05	0.58	56.86	2.77	94.49	0.011
GpAnR-1583	<0.01	1.54	57.19	7.36	91.42	0.006
GpAnR-1584	<0.01	0.62	57.84	2.96	96.01	0.010
GpAnR-1585	<0.01	0.76	57.80	3.63	95.41	0.011
GpAnR-1586	<0.01	0.95	58.17	4.54	95.32	0.013
GpAnR-1587	<0.01	0.55	55.73	2.63	92.68	0.009
GpAnR-1588	<0.01	1.45	56.14	6.93	89.98	0.009
GpAnR-1589	0.08	3.03	56.39	14.48	84.43	0.007
GpAnR-1590	0.03	11.04	51.96	52.75	46.60	0.005
GpAnR-1591	0.08	3.01	57.00	14.38	85.54	0.006
GpAnR-1592	0.01	19.39	44.24	92.65	1.90	0.005
GpAnR-1593	0.02	20.05	45.23	95.80	1.09	0.006
GpAnR-1594	<0.01	20.80	46.70	99.38	0.75	0.004
GpAnR-1595	0.04	20.68	46.67	98.81	1.15	0.005
GpAnR-1596	0.05	20.35	45.44	97.23	0.31	0.005
Occurrence 0010						
GpAnR-51	<0.01	19.20	43.55	91.75	1.44	0.005
GpAnR-52	0.03	18.64	43.34	89.07	3.21	0.010
GpAnR-53	<0.01	18.93	43.49	90.46	2.36	0.011
GpAnR-54	0.02	17.76	40.74	84.87	2.11	0.014

Sample Number	Moisture %	Comb H ₂ O %	SO ₃ %	Gypsum %	Anhydrite %	NaCl %	CaO %	CaCO ₃ %	SiO ₂ %	Al ₂ O ₃ %	K ₂ O %	MgO %	B ppm	Ba ppm	Sr ppm
GpAnR-55	<0.01	18.96	42.68	90.60	0.87	0.010	34.41	8.05	0.87	<0.10	0.02	0.03	<50	21	670
GpAnR-57	<0.01	19.06	43.18	91.08	1.34	0.011	34.49	7.57	0.59	<0.10	0.006	0.03	<50	5	800
GpAnR-58	0.20	18.65	42.97	89.12	2.54	0.010	34.15	7.22	0.91	0.12	0.05	0.04	<50	5	480
GpAnR-59	0.51	18.34	41.30	87.64	0.87	0.010	34.59	10.10	0.62	0.10	0.03	0.05	<50	8	580
GpAnR-60	0.05	18.58	42.73	88.79	2.39	0.012	34.15	7.52	0.62	0.16	0.04	0.05	<50	5	500
GpAnR-61	0.21	18.94	42.44	90.51	0.54	0.011	34.74	8.94	0.92	0.33	0.03	0.05	<50	5	920
GpAnR-62	<0.01	20.27	46.13	96.86	1.78	0.006	32.60	0.51	0.39	0.10	0.02	0.04	<50	5	350
GpAnR-63	<0.01	18.13	41.41	86.63	1.85	0.016	31.63	4.68	5.54	1.18	0.21	0.34	<50	29	690
Occurrence 0011															
GpAnR-64	0.01	19.82	45.19	94.71	1.89	0.024	33.98	4.15	0.67	<0.10	0.03	0.08	<50	5	740
Occurrence 0012															
GpAnR-66A	0.88	20.11	45.37	96.10	1.10	0.006	32.13	0.62	0.67	0.16	0.04	0.36	<50	9	240
GpAnR-67	0.08	20.46	45.78	97.77	0.47	0.007	32.81	1.32	0.71	0.16	0.06	0.07	55	35	460
GpAnR-68	<0.01	20.11	45.48	96.10	1.28	0.020	32.97	1.98	0.13	<0.10	0.02	0.24	<50	9	870
GpAnR-69	0.12	19.89	45.28	95.04	1.78	0.009	31.75	0.06	0.24	0.10	0.02	0.34	<50	21	1150
GpAnR-70	0.10	18.21	40.82	87.02	0.55	0.029	29.72	2.12	5.64	1.10	0.34	0.85	<50	95	2500
GpAnR-71	0.43	20.22	45.72	96.62	1.28	0.128	32.81	2.04	0.41	<0.10	0.03	0.07	<50	14	900
GpAnR-72	0.07	20.03	44.89	95.71	0.58	0.048	32.72	2.27	0.75	<0.10	0.04	0.15	<50	33	700
GpAnR-73	0.17	18.16	40.46	86.78	0.12	0.011	30.45	3.76	4.90	1.00	0.33	1.25	55	190	520
Occurrence 0013															
GpAnR-74	0.06	14.36	49.02	68.62	29.05	0.129	35.35	1.81	0.39	<0.10	0.02	0.15	50	15	1400
GpAnR-75	0.03	20.44	45.64	97.67	0.31	0.006	32.81	1.50	0.60	0.12	0.03	0.10	50	52	550
GpAnR-76	<0.01	12.53	28.61	59.88	1.26	0.014	39.08	33.97	2.11	0.46	0.11	0.98	55	51	580
GpAnR-160	<0.01	19.73	45.07	94.28	2.02	0.005	32.91	2.39	0.25	<0.10	0.03	0.53	55	17	470
GpAnR-161	0.04	19.14	43.99	91.46	2.42	0.013	32.47	2.95	1.16	0.28	0.06	0.26	60	49	1100
Occurrence 0014															
GpAnR-77	<0.01	19.80	45.20	94.61	1.98	0.010	32.98	2.35	0.95	0.12	0.04	0.06	60	41	650
GpAnR-78	<0.01	19.71	44.49	94.18	1.11	0.003	32.81	2.93	1.60	0.22	0.06	0.16	60	78	1600
GpAnR-79	<0.01	19.84	44.24	94.81	0.20	0.004	32.47	2.64	0.67	0.16	0.06	0.62	50	31	400
GpAnR-80	<0.01	20.21	44.98	96.57	0.06	0.025	32.62	1.98	0.67	<0.10	0.01	0.16	65	17	360
GpAnR-81	<0.01	19.67	44.17	93.99	0.72	0.023	32.47	2.67	0.83	<0.10	0.02	0.19	65	37	1300
GpAnR-82	<0.01	20.21	45.39	96.14	1.09	0.011	32.81	1.81	0.38	<0.10	0.02	0.23	65	2	340
GpAnR-87A	<0.01	9.06	21.10	43.29	1.62	0.010	43.57	51.38	1.96	0.12	0.04	0.20	<50	18	570
GpAnR-88	<0.01	20.14	46.01	96.24	2.07	0.006	32.80	1.01	0.59	0.14	0.03	0.03	70	35	3700





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GpAnR-1493	<0.01	5.46	51.01	26.09	66.09	0.026									
GpAnR-1494	0.11	8.17	52.01	39.04	57.54	0.012									
GpAnR-1495	0.08	8.97	49.17	42.86	49.69	0.016									
GpAnR-1496	0.05	5.41	46.91	25.85	59.31	0.012									
GpAnR-1497	0.08	7.68	48.46	36.70	53.36	0.014									
GpAnR-1498	0.04	4.57	54.20	21.84	74.88	0.008									
GpAnR-1499	0.07	8.07	46.76	38.56	48.99	0.012									
GpAnR-1500	0.03	20.54	46.51	98.14	1.41	0.007									
GpAnR-1501	0.03	14.89	33.66	71.14	0.93	0.009									
GpAnR-1502	0.07	20.09	44.86	95.99	0.31	0.005									
GpAnR-1503	0.02	20.60	46.35	98.43	0.91	0.005									
GpAnR-1504	0.02	20.71	46.51	98.95	0.77	0.004									
GpAnR-1505	0.01	11.69	51.02	55.86	42.55	0.013									
GpAnR-1506	<0.01	1.58	56.33	7.55	89.81	0.009									
GpAnR-1507	<0.01	1.36	58.18	6.50	93.79	0.009									
GpAnR-1508	0.04	4.93	47.45	23.56	62.04	0.023									
GpAnR-1509	0.04	2.24	53.17	10.70	81.94	0.005									
GpAnR-1510	0.01	1.48	55.15	7.07	88.18	0.004									
GpAnR-1511	0.02	3.45	41.92	16.48	58.23	0.010									
Occurrence 0015															
GpAnR-85	0.10	20.02	44.76	95.67	0.40	0.007	31.97	1.10	1.48	0.12	0.04	0.35	<50	34	200
GpAnR-86	0.28	18.47	41.64	88.26	0.96	0.011	30.03	1.54	6.02	1.23	0.18	1.22	<50	79	1050
GpAnR-87	0.14	20.22	46.03	96.62	1.79	0.003	32.28	<0.10	0.25	0.14	0.03	0.13	<50	48	1100
Occurrence 0016															
GpAnR-91	0.04	19.88	44.89	95.00	1.15	0.004	52.97	2.72	0.25	0.19	0.03	0.19	60	32	700
GpAnR-92	<0.01	20.08	45.13	95.95	0.80	0.004	31.62	<0.10	0.15	0.14	0.02	0.49	<50	13	320
GpAnR-93	<0.01	19.21	43.29	91.80	0.96	0.005	32.64	4.13	0.15	0.32	0.07	1.12	<50	21	450
GpAnR-94	<0.01	20.44	46.23	97.67	1.31	0.003	31.97	0.73	1.27	0.14	0.02	0.05	60	13	880
GpAnR-94A	0.06	17.74	40.27	84.77	1.39	0.005	29.44	2.19	11.07	1.25	0.18	0.47	55	62	960
GpAnR-95	<0.01	19.97	45.30	95.43	1.51	0.007	32.74	1.81	0.25	0.14	0.02	0.64	70	22	1300
Occurrence 0017															
GpAnR-96	0.17	19.61	44.90	93.70	2.19	0.058	31.96	0.92	1.87	0.40	0.05	0.06	55	42	850
GpAnR-97	0.07	19.95	45.55	95.33	2.00	0.008	32.65	1.33	0.25	0.14	0.01	0.02	55	34	680
GpAnR-98	0.17	19.06	43.67	91.07	2.18	0.013	34.15	6.35	0.25	0.14	0.02	0.04	55	38	1600
GpAnR-99	0.15	19.00	43.93	90.79	2.85	0.009	33.31	4.53	0.57	0.22	0.03	0.05	<50	26	520

GpAnR-100	0.20	19.30	44.18	92.22	2.14	0.008	34.15	5.71	0.25	0.18	0.02	0.05	<50	24	360
GpAnR-101	0.13	19.48	44.44	93.08	1.90	0.044	32.81	3.00	0.15	0.18	0.02	0.05	<50	14	310
GpAnR-102	0.15	18.74	42.50	89.54	1.40	0.038	34.21	7.92	0.59	0.18	0.02	0.07	<50	21	460
GpAnR-103	0.10	19.86	45.26	94.90	1.85	0.016	31.97	0.50	0.25	0.14	0.02	0.03	<50	22	420
GpAnR-104	0.19	19.61	44.00	93.71	0.66	0.116	31.97	2.05	0.45	0.14	0.02	0.05	<50	22	690
GpAnR-105	0.13	19.11	43.35	91.31	1.44	0.027	33.00	4.70	0.47	0.18	0.03	0.05	<50	8	430
GpAnR-106	0.19	18.68	42.58	89.26	1.76	0.046	33.90	7.28	0.60	0.14	0.02	0.05	<50	15	580
GpAnR-107	0.38	18.98	43.21	90.70	1.88	0.061	33.14	5.12	0.39	0.18	0.02	0.05	<50	12	360
GpAnR-108	0.12	20.09	45.16	96.00	0.81	0.029	32.81	2.10	0.33	0.14	0.02	0.04	<50	33	350
GpAnR-109	0.08	20.01	45.46	95.61	1.62	0.018	32.97	2.00	0.97	0.14	0.02	0.04	<50	22	350
GpAnR-110	0.10	19.67	45.19	94.00	2.45	0.021	32.97	2.35	0.72	0.14	0.03	0.05	<50	29	350
GpAnR-111	0.13	19.02	43.86	90.89	2.65	0.01	33.65	5.22	0.61	0.22	0.05	0.06	<50	39	660
GpAnR-112	0.15	19.06	43.79	91.08	2.38	0.008	34.32	6.50	0.22	0.14	0.02	0.04	<50	20	600
GpAnR-113	0.07	18.30	41.49	87.45	1.34	0.006	35.23	11.00	0.22	0.14	0.01	0.07	<50	22	670
GpAnR-115	0.81	19.39	43.96	92.65	1.42	0.070	33.08	4.08	0.95	0.14	0.04	0.10	<50	13	490
GpAnR-116	<0.01	19.68	44.45	94.04	1.16	0.019	33.31	3.88	0.89	0.14	0.03	0.07	<50	34	700
GpAnR-117	0.06	19.31	43.99	92.27	1.77	0.012	34.15	5.95	0.22	0.14	0.01	0.06	60	34	630
GpAnR-118	0.05	19.91	45.29	95.13	1.71	0.008	32.79	1.90	0.44	0.14	0.02	0.04	70	39	420
GpAnR-119	<0.01	16.53	39.60	78.99	4.82	0.011	35.59	14.01	0.54	0.14	0.03	0.11	50	52	1100
GpAnR-120	<0.01	18.05	41.02	86.25	1.49	0.004	34.51	10.30	0.54	0.14	0.04	0.10	65	60	2700
GpAnR-121	<0.01	19.23	43.63	91.89	1.47	0.012	32.43	3.33	0.54	0.14	0.04	0.07	70	54	800
GpAnR-136	0.08	19.44	44.56	92.89	2.08	0.01	31.37	0.28	2.04	0.46	0.05	0.10	50	58	520
GpAnR-137	0.20	15.37	48.49	73.44	24.32	0.059	34.82	1.02	0.73	0.20	0.007	0.16	50	30	730
GpAnR-138	0.20	1.97	48.20	9.41	74.50	0.083	41.22	13.31	0.59	0.22	0.03	0.19	<50	7	1600
GpAnR-139	0.12	18.65	43.01	89.11	2.60	0.081	33.88	6.69	1.14	0.30	0.07	0.19	70	42	1500
GpAnR-140	0.58	19.05	43.11	91.03	1.27	0.27	33.33	5.59	0.86	0.20	0.04	0.12	70	68	1600
GpAnR-141	0.07	18.29	42.35	87.40	2.84	0.023	34.32	8.31	0.42	0.12	0.02	0.09	70	75	5800
GpAnR-142	0.03	18.28	42.12	87.35	2.49	0.007	33.73	7.54	0.42	0.18	0.02	0.09	55	48	1400
Occurrence 0018															
GpAnR-122	<0.01	2.97	55.39	14.19	82.95	0.14	39.40	1.42	0.13	0.14	0.02	0.06	<50	15	1000
GpAnR-123	<0.01	19.75	46.21	94.37	3.88	0.043	32.63	0.46	0.22	0.14	0.01	0.06	65	50	880
GpAnR-124	0.04	19.61	45.62	93.71	3.41	0.033	33.14	2.11	0.44	0.14	0.04	0.07	65	40	650
GpAnR-125	0.33	19.35	45.00	92.47	3.34	0.25	31.63	0.20	1.50	0.20	0.07	0.30	65	46	520
GpAnR-126	0.13	19.99	45.46	95.52	1.70	0.011	33.42	2.81	0.22	0.14	0.01	0.22	70	39	580
GpAnR-127	0.03	20.09	45.64	96.00	1.63	0.009	32.98	1.80	0.54	0.14	0.04	0.07	70	44	510
GpAnR-128	0.02	19.83	45.36	94.75	2.14	0.056	33.15	2.45	0.82	0.14	0.06	0.14	55	41	600
GpAnR-129	0.12	19.86	45.34	94.90	1.99	0.025	32.80	1.86	0.62	0.14	0.03	0.25	65	34	1500
GpAnR-130	0.06	19.48	45.26	93.08	3.29	0.018	33.14	2.56	0.52	0.14	0.03	0.23	50	30	580

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Occurrence 0019															
GpAnR-131	0.19	17.78	41.21	84.96	2.83	0.010	33.31	7.93	1.47	0.14	0.06	1.82	75	44	200
GpAnR-132	0.04	19.98	45.36	95.47	1.57	0.007	32.27	0.88	0.22	0.14	0.03	0.30	65	20	190
GpAnR-132A	<0.01	19.07	44.00	91.12	2.70	0.008	32.97	3.84	0.59	0.30	0.08	0.55	90	30	290
GpAnR-134	<0.01	19.58	45.79	93.56	3.81	0.008	33.48	2.50	0.19	0.50	0.007	0.01	<50	13	740
GpAnR-135	0.10	19.86	45.19	94.90	1.73	0.006	32.72	1.90	0.19	0.20	0.007	0.39	<50	37	570
Occurrence 0020															
GpAnR-143	0.04	19.94	46.10	95.28	2.98	0.010	32.80	0.90	0.51	0.22	0.02	0.04	75	42	1000
GpAnR-144	0.07	18.59	43.36	88.83	3.43	0.014	32.81	4.34	0.97	0.22	0.04	1.24	75	37	900
GpAnR-145	<0.01	19.45	44.82	92.94	2.66	0.007	52.51	2.52	0.82	0.18	0.05	0.33	65	60	1500
GpAnR-146	<0.01	19.85	45.78	94.85	2.78	0.008	33.11	1.86	0.40	0.10	0.08	0.08	80	17	690
GpAnR-147	<0.01	20.44	45.62	97.67	0.27	0.032	32.43	0.84	0.30	0.10	0.004	0.03	75	23	620
GpAnR-148	0.08	20.01	45.14	95.62	1.08	0.014	33.48	3.30	0.69	0.24	0.04	0.21	70	29	790
GpAnR-149	0.09	20.23	46.15	96.67	1.97	0.013	33.15	1.47	0.30	0.18	0.007	0.14	80	26	500
GpAnR-150	<0.01	18.76	43.42	89.64	2.89	0.009	33.98	6.50	0.51	0.24	0.03	1.25	85	90	1600
GpAnR-151	0.06	19.96	46.04	95.38	2.81	0.006	32.30	0.10	1.04	0.32	0.10	0.18	85	37	670
GpAnR-152	<0.01	19.78	45.32	94.51	2.26	0.009	33.22	2.63	0.82	0.14	0.03	0.51	55	10	710
GpAnR-157	0.70	19.75	46.20	94.37	3.87	0.010	32.82	0.82	0.16	<0.10	0.02	0.04	55	9	460
Occurrence 0021															
GpAnR-153	<0.01	20.07	45.63	95.90	1.69	0.006	32.26	0.53	0.88	0.20	0.01	0.03	60	23	200
GpAnR-154	<0.01	20.10	45.39	96.05	1.17	0.005	33.10	2.33	1.10	0.20	0.03	0.13	50	24	160
GpAnR-155	0.07	19.23	44.39	91.89	2.77	0.077	32.54	2.58	2.80	0.38	0.08	0.49	60	41	530
GpAnR-156	0.14	18.82	42.80	89.93	1.61	0.065	32.13	3.83	0.55	0.21	0.05	1.35	55	19	450
Occurrence 0022															
GpAnR-158	<0.01	17.91	42.05	85.58	3.78	0.003	32.23	4.95	1.64	0.32	0.10	1.43	<50	270	1000
GpAnR-159	0.02	20.29	45.88	96.96	1.28	0.006	33.03	1.59	0.24	<0.10	0.02	0.04	50	830	15
Occurrence 0023															
GpAnR-162	0.05	19.89	44.88	95.04	1.10	0.012	32.30	1.54	0.42	<0.10	0.03	0.60	50	27	500
GpAnR-163	0.02	20.38	46.49	97.38	1.98	0.004	32.81	0.44	0.49	<0.10	0.02	0.07	60	7	260
GpAnR-310	<0.01	20.50	46.53	97.95	1.60	0.006									
GpAnR-311	<0.01	20.83	46.52	99.53	0.33	0.006									
GpAnR-312	<0.01	20.89	46.90	99.81	0.75	0.006									

## Occurrence 0024

GpAnR-164	0.07	0.72	57.71	3.43	95.41	0.016	40.71	0.51	0.16	<0.10	0.02	0.12	85	1	700
GpAnR-165	0.01	4.25	55.61	20.31	78.49	0.005	39.53	1.03	0.16	<0.10	0.02	0.14	75	4	500
GpAnR-166	0.03	20.60	46.43	98.43	1.04	0.006	32.62	0.17	0.25	<0.10	0.31	0.02	50	17	540
GpAnR-168	6.56	20.40	46.13	97.50	1.30	0.009	32.50	0.33	0.25	<0.10	0.02	0.03	50	19	260
GpAnR-169	0.01	7.89	53.13	37.70	60.50	0.004	37.33	0.20	0.25	<0.10	0.02	0.14	60	8	1200
GpAnR-174	<0.01	20.46	46.45	97.77	1.60	0.005	33.11	1.02	0.26	<0.10	0.02	0.11	55	30	640
GpAnR-175	<0.01	20.50	45.87	97.96	0.47	0.003	32.30	0.30	0.25	<0.10	0.01	0.18	55	39	690
GpAnR-176	<0.01	20.42	46.37	97.58	1.62	0.002	33.31	1.47	0.34	<0.10	0.02	0.08	60	22	610
GpAnR-177	0.03	20.41	46.11	97.53	1.22	<0.001	32.64	0.61	0.34	0.12	0.02	0.16	50	28	790
GpAnR-178	0.06	20.38	45.63	97.38	0.51	0.004	32.64	1.21	0.27	0.17	0.02	0.10	65	38	840
GpAnR-179	0.02	8.88	52.94	42.43	56.43	0.003	37.48	0.71	0.38	<0.10	0.02	0.11	75	3	1000
GpAnR-180	<0.01	11.66	50.44	55.71	41.67	0.003	35.46	0.21	0.50	0.17	0.03	0.19	75	50	880

## Occurrence 0025

GpAnR-167	0.06	20.57	46.23	98.29	0.82	0.001	32.42	<0.10	0.25	<0.10	0.02	0.02	70	22	1200
GpAnR-170	<0.01	20.64	46.53	98.62	1.06	0.008	33.01	0.74	0.34	<0.10	0.03	0.03	55	22	800
GpAnR-171	0.18	8.72	52.74	41.66	56.70	0.009	37.18	0.42	0.25	<0.10	0.03	0.10	110	14	850
GpAnR-172	0.01	8.00	53.56	38.24	60.81	0.003	37.54	<0.10	0.34	<0.10	0.02	0.08	85	13	920
GpAnR-173	0.04	3.00	55.61	14.33	83.21	0.010	40.28	2.36	0.16	<0.10	0.03	0.10	100	13	920
GpAnR-181	<0.01	12.66	49.68	60.49	36.60	0.003	34.02	<0.10	0.46	0.12	0.02	0.26	75	3	680
GpAnR-182	0.12	19.99	45.37	95.52	1.55	0.003	33.14	2.42	0.71	0.12	0.03	0.07	65	24	680
GpAnR-183	<0.01	1.76	54.01	8.41	88.84	0.008	39.20	2.44	0.28	<0.10	0.02	0.16	95	1	780
GpAnR-184	0.10	11.68	50.95	55.81	42.46	0.006	36.02	0.57	0.42	0.12	0.03	0.14	75	34	800
GpAnR-185	<0.01	19.81	45.35	94.66	2.19	0.002	32.81	1.86	0.82	0.24	0.04	0.14	50	35	620
GpAnR-186	0.01	8.91	52.11	42.57	54.91	0.003	38.97	1.38	0.47	<0.10	0.02	0.20	60	23	900
GpAnR-187	0.01	7.53	52.94	35.98	61.54	0.005	37.63	0.97	0.47	<0.10	0.02	0.20	60	10	1100
GpAnR-188	0.03	8.88	51.88	42.43	54.30	0.007	36.50	0.28	0.28	<0.10	0.02	0.26	75	8	1100
GpAnR-189	0.04	8.07	53.11	38.56	59.79	0.007	38.86	2.96	0.15	0.12	0.03	0.12	65	7	800
GpAnR-190	0.06	11.87	50.67	56.72	41.28	0.010	36.01	0.92	0.47	0.12	0.05	0.12	55	10	860
GpAnR-191	0.05	5.84	54.58	27.91	70.72	0.005	38.86	1.12	0.42	<0.10	0.03	0.14	95	7	1300
GpAnR-192	0.01	11.42	50.93	54.57	43.41	0.002	36.67	1.77	0.42	0.12	0.03	0.15	75	18	1100
GpAnR-193	0.04	20.55	46.30	98.19	1.01	0.003	32.45	0.03	0.50	<0.10	0.02	0.04	<50	29	530
GpAnR-194	0.03	13.45	50.08	64.28	34.29	0.004	35.87	1.41	0.47	0.12	0.02	0.15	65	20	660
GpAnR-195	<0.01	20.38	46.55	97.38	2.08	<0.001	32.67	0.11	0.34	0.12	0.02	0.04	60	32	540
GpAnR-196	<0.01	12.14	50.51	58.01	39.97	0.004	35.43	0.09	0.67	0.12	0.02	0.13	80	16	920
GpAnR-197	0.08	14.27	49.99	68.19	31.03	0.002	35.16	0.25	0.28	0.12	0.02	0.11	65	26	700
GpAnR-198	<0.01	3.04	55.89	14.53	83.53	0.010	39.53	0.67	0.53	<0.10	0.02	0.20	100	6	1100
GpAnR-199	0.03	6.31	54.11	30.15	68.14	0.004	37.99	0.15	0.20	<0.10	0.02	0.06	85	5	1100
GpAnR-200	0.01	5.43	54.53	25.93	72.19	0.004	38.97	1.38	0.38	<0.10	0.02	0.23	60	18	830





GpAnR-1629	0.17	0.70	58.09	3.35	96.13	0.010
GpAnR-1630	0.15	0.74	57.84	3.54	95.55	0.012
GpAnR-1631	0.16	0.74	57.29	3.54	94.62	0.011
GpAnR-1632	0.07	0.58	55.68	2.77	92.49	0.009
GpAnR-1633	0.06	0.82	55.42	3.92	91.14	0.009
GpAnR-1634	0.08	0.52	52.86	2.49	87.92	0.008
GpAnR-1635	0.06	0.60	53.36	2.87	88.46	0.011
GpAnR-1636	0.12	0.47	50.45	2.25	84.01	0.008
GpAnR-1637	0.06	0.53	58.24	2.53	97.03	0.005
GpAnR-1638	0.15	0.62	58.36	2.96	96.89	0.008
GpAnR-1639	0.07	0.73	58.60	3.49	96.88	0.008
GpAnR-1640	0.09	0.44	55.59	2.10	92.86	0.008
GpAnR-1641	0.07	0.55	57.48	2.63	95.66	0.006
GpAnR-1642	0.05	0.83	57.22	3.97	94.16	0.008
GpAnR-1643	<0.01	1.95	53.18	9.32	83.05	0.006
GpAnR-1644	<0.01	2.30	48.00	10.99	72.92	0.008
GpAnR-1645	0.03	0.62	56.98	2.96	94.54	0.006
GpAnR-1646	<0.01	0.60	58.65	2.87	97.46	0.006
GpAnR-1647	<0.01	0.64	58.51	3.06	97.07	0.009
GpAnR-1648	<0.01	0.55	58.65	2.63	97.65	0.011
GpAnR-1649	<0.01	1.35	56.64	6.45	91.21	0.007
GpAnR-1650	<0.01	0.86	58.21	4.11	95.73	0.008
GpAnR-1651	<0.01	0.92	58.21	4.40	95.50	0.006
GpAnR-1652	<0.01	4.24	54.13	20.26	76.01	0.005
Occurrence 0029						
GpAnR-1446	<0.01	17.76	40.07	84.86	0.97	0.005
GpAnR-1447	<0.01	18.77	42.12	89.68	0.64	0.007
GpAnR-1448	<0.01	4.29	50.41	20.50	69.49	0.007
GpAnR-1449	0.02	2.14	52.20	10.23	80.67	0.008
GpAnR-1450	<0.01	6.01	50.05	28.72	62.38	0.011
GpAnR-1451	<0.01	5.84	47.23	27.90	58.23	0.007
GpAnR-1452	<0.01	5.63	43.21	26.90	52.18	0.008
Occurrence 0030						
GpAnR-1453	<0.01	20.87	46.65	99.72	0.40	0.005
GpAnR-1454	<0.01	19.84	46.02	94.80	3.23	0.004
Occurrence 0031						
GpAnR-364A	<0.01	20.68	46.31	98.81	0.54	0.041
GpAnR-365	<0.01	20.44	45.69	97.66	0.40	0.007



GpAnR-1334	<0.01	0.95	55.78	4.54	91.26	0.012
GpAnR-1335	<0.01	0.72	57.03	3.44	94.25	0.012
GpAnR-1336	<0.01	0.67	56.80	3.20	94.05	0.014
GpAnR-1337	<0.01	0.70	55.22	3.35	91.25	0.013
GpAnR-1338	0.06	0.85	54.77	4.06	89.92	0.014
GpAnR-1339	<0.01	0.99	56.37	4.73	92.11	0.019
GpAnR-1340	<0.01	0.89	55.82	4.25	91.55	0.016
GpAnR-1341	0.03	0.31	49.81	1.48	83.53	0.016
GpAnR-1342	0.04	0.23	54.38	1.10	91.60	0.018
GpAnR-1343	0.02	0.47	54.39	2.25	90.71	0.045
GpAnR-1344	0.06	0.23	56.07	1.10	94.47	0.011
GpAnR-1345	0.05	0.28	56.71	1.34	95.37	0.017
GpAnR-1346	0.04	0.28	57.33	1.34	96.43	0.013
GpAnR-1347	0.02	0.57	43.39	2.72	71.62	0.023
GpAnR-1348	0.04	0.27	56.09	1.29	94.35	0.013
GpAnR-1349	<0.01	0.71	45.73	3.39	75.07	0.027
GpAnR-1350	0.01	0.30	35.04	1.43	58.45	0.055
GpAnR-1351	<0.01	0.17	52.05	0.81	87.86	0.014
GpAnR-1352	<0.01	0.25	56.06	1.20	94.38	0.020
GpAnR-1353	<0.01	0.53	56.96	2.53	94.85	0.016
GpAnR-1354	<0.01	0.56	54.61	2.68	90.74	0.022
GpAnR-1355	0.04	0.81	39.31	3.87	63.78	0.040
GpAnR-1356	0.03	0.42	39.33	2.01	65.29	0.034
GpAnR-1357	0.03	0.49	53.54	2.34	89.19	0.019
GpAnR-1358	<0.01	0.46	45.78	2.20	76.11	0.039
GpAnR-1359	<0.01	0.42	47.04	2.01	78.40	0.030
GpAnR-1360	<0.01	0.60	52.16	2.87	86.42	0.030
GpAnR-1361	<0.01	0.82	50.91	3.92	83.47	0.022
GpAnR-1362	<0.01	0.52	55.86	2.49	93.02	0.019
GpAnR-1363	<0.01	0.75	56.12	3.58	92.59	0.022
GpAnR-1364	<0.01	0.55	58.34	2.63	97.12	0.013
GpAnR-1365	<0.01	0.38	56.85	1.82	95.23	0.017
GpAnR-1366	<0.01	0.37	57.49	1.77	96.36	0.017
GpAnR-1367	<0.01	0.77	49.96	3.68	82.04	0.021
GpAnR-1368	<0.01	0.68	49.11	3.25	80.94	0.022
GpAnR-1369	<0.01	0.65	50.80	3.11	83.92	0.021
GpAnR-1370	<0.01	0.68	56.76	3.25	93.94	0.023
GpAnR-1371	<0.01	0.59	58.11	2.82	96.58	0.017
GpAnR-1372	<0.01	0.84	57.33	4.01	94.31	0.030
GpAnR-1373	<0.01	0.68	42.77	3.25	70.15	0.032
GpAnR-1374	0.08	0.47	56.01	2.25	93.46	0.022





GpAnR-1413	0.01	0.70	56.87	3.35	94.06	0.013
GpAnR-1414	0.04	0.70	55.10	3.35	91.05	0.022
GpAnR-1415	0.02	0.57	53.74	2.72	89.22	0.015
GpAnR-1416	0.03	0.62	37.61	2.96	61.61	0.032
GpAnR-1417	<0.01	0.54	47.35	2.58	78.47	0.032
GpAnR-1418	<0.01	0.36	52.81	1.72	88.44	0.017
GpAnR-1419	<0.01	0.72	43.81	3.44	71.77	0.026
GpAnR-1420	<0.01	0.68	46.52	3.25	76.53	0.024
GpAnR-1421	<0.01	0.74	54.78	3.54	90.35	0.017
GpAnR-1422	0.02	0.55	55.69	2.63	92.62	0.014
GpAnR-1423	<0.01	2.07	55.11	9.89	85.88	0.009
GpAnR-1424	<0.01	0.45	57.70	2.15	96.41	0.019
GpAnR-1425	<0.01	0.48	57.95	2.29	96.72	0.016
GpAnR-1426	<0.01	0.60	57.51	2.87	95.52	0.033
GpAnR-1427	<0.01	0.65	57.57	3.11	95.43	0.018
GpAnR-1428	0.03	0.23	55.75	1.10	93.93	0.028
GpAnR-1429	0.03	0.19	54.07	0.91	91.22	0.019
GpAnR-1430	0.01	0.29	55.63	1.39	93.50	0.031
GpAnR-1431	0.03	0.20	53.39	0.96	90.03	0.027
GpAnR-1432	<0.01	0.20	55.95	0.96	94.38	0.020
GpAnR-1433	<0.01	0.31	56.19	1.48	94.37	0.021
GpAnR-1434	<0.01	0.61	48.78	2.92	80.64	0.028
GpAnR-1435	<0.01	0.71	54.97	3.39	90.79	0.025
GpAnR-1436	<0.01	1.28	56.98	6.12	92.05	0.015
GpAnR-1437	0.02	0.45	56.54	2.15	94.44	0.012
GpAnR-1438	<0.01	0.64	57.05	3.06	94.59	0.020
GpAnR-1439	<0.01	12.03	50.90	57.48	41.06	0.055
GpAnR-1440	<0.01	20.24	45.58	96.71	0.97	0.030
GpAnR-1441	<0.01	19.92	44.40	95.18	0.17	0.022
GpAnR-1442	<0.01	20.60	45.86	98.43	0.08	0.031
GpAnR-1443	<0.01	20.67	46.02	98.76	0.09	0.019
GpAnR-1444	<0.01	19.57	43.57	93.51	0.08	0.047
GpAnR-1445	<0.01	19.66	44.11	93.94	0.66	0.039
GpAnR-609	0.12	20.38	46.18	97.38	1.46	0.009
GpAnR-610	1.37	19.60	43.94	93.65	0.60	0.011
Occurrence 0038						
GpAnR-342	0.06	20.84	46.68	99.57	0.57	0.015



GpAnR-1062	<0.01	19.43	44.83	92.84	2.75	0.012
GpAnR-1063	<0.01	12.25	51.29	58.53	40.89	0.035
GpAnR-1064	<0.01	10.86	51.41	51.89	46.35	0.038
GpAnR-1065	<0.01	11.72	42.51	56.00	27.96	0.044
GpAnR-1066	<0.01	11.78	46.30	56.29	34.18	0.027
GpAnR-1067	<0.01	19.58	47.10	93.55	6.05	0.013
GpAnR-1068	0.05	11.19	49.01	53.47	41.02	0.031
GpAnR-1069	0.03	7.09	53.50	33.88	64.16	0.052
GpAnR-1070	<0.01	13.29	46.84	63.50	29.39	0.027
GpAnR-1071	<0.01	12.45	38.34	59.49	18.11	0.023
GpAnR-1072	<0.01	11.89	47.26	56.81	35.40	0.076
GpAnR-1073	<0.01	13.31	40.45	63.60	18.45	0.054
GpAnR-1074	<0.01	14.42	47.62	68.90	26.44	0.008
GpAnR-1075	<0.01	19.14	47.23	91.45	7.93	0.025
GpAnR-1076	0.02	16.59	44.86	79.27	13.54	0.020
GpAnR-1077	0.02	9.20	51.70	43.96	53.12	0.014
GpAnR-1078	<0.01	11.39	49.94	54.42	41.85	0.063
GpAnR-1079	0.02	7.78	38.84	37.17	36.62	0.130
GpAnR-1080	0.04	9.49	51.74	45.34	52.09	0.026
GpAnR-1081	0.01	12.35	47.97	59.01	34.87	0.039
GpAnR-1082	0.05	12.51	46.28	59.77	31.39	0.043
GpAnR-1083	<0.01	15.92	47.07	76.07	19.84	0.025
GpAnR-1084	<0.01	14.21	46.24	67.90	24.89	0.014
GpAnR-1085	0.12	7.87	25.33	37.60	13.31	0.051
GpAnR-1086	0.04	12.51	50.80	59.77	39.07	0.023
GpAnR-1087	0.01	11.79	50.96	56.33	42.07	0.041
GpAnR-1088	0.02	13.78	47.09	65.84	27.96	0.026
GpAnR-1089	<0.01	12.83	50.44	61.30	37.25	0.036
GpAnR-1090	<0.01	9.77	53.38	46.68	53.82	0.029
GpAnR-1091	<0.01	11.51	51.28	55.00	43.67	0.042
GpAnR-1092	0.05	3.08	54.56	14.72	81.13	0.022
GpAnR-1093	0.06	5.83	53.20	27.86	68.42	0.022
GpAnR-1094	0.02	4.59	53.00	21.93	72.76	0.022
GpAnR-1095	0.03	9.43	48.82	45.06	47.35	0.005
GpAnR-1096	<0.01	5.77	43.32	27.57	51.84	0.011
GpAnR-1097	0.02	13.40	30.58	64.03	1.33	0.007
GpAnR-1098	0.02	12.29	28.84	58.72	2.56	0.009
GpAnR-1099	0.02	19.42	47.07	92.79	6.60	0.005
GpAnR-1100	0.11	17.95	45.32	85.77	9.18	0.044
GpAnR-1101	0.03	6.73	46.94	32.16	54.37	0.024
GpAnR-1102	0.03	20.20	46.56	96.52	2.71	0.010





GpAnR-1141	0.08	20.64	46.87	98.62	1.65	0.003
GpAnR-1142	<0.01	20.78	46.52	99.29	0.52	0.005
GpAnR-1143	0.01	20.36	45.95	97.28	1.14	0.008
GpAnR-1144	<0.01	19.10	43.35	91.26	1.48	0.006
GpAnR-1145	<0.01	20.35	46.63	97.23	2.33	0.007
GpAnR-1146	0.01	20.22	46.35	96.61	2.35	0.004
GpAnR-1147	<0.01	18.19	41.41	86.91	1.63	0.018
GpAnR-1148	<0.01	20.51	45.93	98.00	0.54	0.006
GpAnR-1149	<0.01	4.72	54.31	22.55	74.50	0.031
GpAnR-1150	0.06	7.13	51.47	34.07	60.56	0.078
GpAnR-1151	0.04	19.96	45.95	95.42	2.65	0.006
GpAnR-1152	<0.01	19.80	45.69	94.60	2.82	0.007
GpAnR-1153	<0.01	19.19	44.22	91.69	2.62	0.007
GpAnR-1154	<0.01	18.43	41.65	88.06	1.13	0.013
GpAnR-1155	0.01	20.50	45.80	97.95	0.36	0.010
GpAnR-1156	0.01	19.78	44.11	94.51	0.21	0.021
GpAnR-1157	0.04	20.75	46.40	99.14	0.43	0.009
GpAnR-1158	<0.01	20.87	46.54	99.72	0.22	0.008
GpAnR-1159	0.02	2.58	57.30	12.33	87.68	0.008
GpAnR-1160	0.04	2.39	57.05	11.42	87.97	0.013
GpAnR-1161	0.03	0.98	57.62	4.68	94.27	0.009
GpAnR-1162	0.07	20.71	46.18	98.95	0.21	0.007
GpAnR-1163	0.18	2.55	56.72	12.18	86.80	0.013
GpAnR-1164	0.03	1.32	56.68	6.31	91.39	0.011
GpAnR-1165	0.06	2.77	55.36	13.24	83.66	0.020
GpAnR-1166	0.12	2.89	55.30	13.81	83.10	0.010
GpAnR-1167	0.39	3.78	54.77	18.06	78.84	0.023
GpAnR-1168	0.10	2.92	55.16	13.95	82.75	0.008
GpAnR-1169	0.07	5.17	53.98	24.70	72.24	0.018
GpAnR-1170	0.23	4.40	54.61	21.02	76.22	0.029
GpAnR-1171	0.08	20.62	45.99	98.52	0.23	0.008
GpAnR-1172	<0.01	20.63	46.30	98.57	0.71	0.005
GpAnR-1173	0.02	20.33	45.34	97.14	0.22	0.007
GpAnR-1174	<0.01	20.29	45.56	96.95	0.74	0.008
GpAnR-1175	0.07	20.83	46.72	99.53	0.67	0.010
GpAnR-1176	0.17	18.58	46.81	88.78	9.33	0.010
GpAnR-1177	0.02	17.40	40.69	83.14	3.39	0.015
GpAnR-1178	<0.01	20.28	45.58	96.90	0.81	0.025
GpAnR-1179	0.14	20.55	46.12	98.19	0.71	0.025
GpAnR-1180	0.06	20.68	46.21	98.81	0.31	0.018
GpAnR-1181	0.16	20.19	45.95	96.47	1.78	0.009



GpAnR-249	0.02	7.45	54.48	35.60	64.47	0.017
GpAnR-250	<0.01	20.43	46.45	97.62	1.73	0.045
GpAnR-251	<0.01	5.71	53.24	27.28	68.94	0.001

## Occurrence 0053

GpAnR-238	<0.01	20.71	46.87	98.95	1.38	0.073
GpAnR-239	0.04	20.54	45.75	98.14	0.12	0.094
GpAnR-240	<0.01	20.38	45.83	97.38	0.86	0.036
GpAnR-241	<0.01	20.07	44.95	95.90	0.54	0.034
GpAnR-242	0.02	20.35	45.62	97.23	0.62	0.100
GpAnR-243	0.02	20.33	45.38	97.14	0.28	0.019
GpAnR-244	0.03	19.68	44.33	94.03	0.96	0.026
GpAnR-245	0.01	20.48	44.82	97.85	0.47	0.044

## Occurrence 0055

GpAnR-252	<0.01	20.75	46.27	99.14	0.21	0.003
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## Occurrence 0056

GpAnR-253	0.03	20.24	46.01	96.71	1.70	0.004
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## Occurrence 0057

GpAnR-254	0.01	20.83	46.52	99.53	0.33	0.004
GpAnR-255	0.04	20.68	46.11	98.81	0.20	0.007
GpAnR-256	0.02	20.35	46.29	97.23	1.76	0.001
GpAnR-257	0.07	20.18	45.72	96.42	1.43	0.001
GpAnR-258	0.03	1.86	4.41	8.88	0.47	0.011
GpAnR-259	0.01	20.48	45.87	97.85	0.55	0.006
GpAnR-606	0.04	18.81	43.36	89.87	2.60	0.011
GpAnR-607	0.10	18.83	43.28	89.97	2.39	0.021

## Occurrence 0058

GpAnR-260	0.03	20.48	45.86	97.85	0.53	0.091
GpAnR-261	0.05	20.83	46.75	99.53	0.72	0.076
GpAnR-262	0.01	20.45	45.75	97.71	0.46	0.111
GpAnR-263	0.04	19.59	44.54	93.60	1.65	0.118
GpAnR-264	0.02	19.97	44.62	95.42	0.35	0.004
GpAnR-265	0.03	19.75	44.09	94.37	0.28	0.146
GpAnR-266	0.02	18.98	42.28	90.69	0.12	0.007
GpAnR-267	<0.01	20.84	46.43	99.57	0.14	0.024
GpAnR-268	0.03	19.26	43.17	92.02	0.57	0.094





GpAnR-291	0.06	13.92	50.93	66.51	33.96	0.011
GpAnR-292	0.04	7.39	54.43	35.31	64.61	0.016
Occurrence 0067						
GpAnR-293	0.04	19.26	43.00	92.02	0.28	0.011
GpAnR-294	0.05	17.71	39.49	84.62	0.18	0.017
Occurrence 0068						
GpAnR-313	0.01	20.33	45.85	97.14	1.08	0.004
GpAnR-314	<0.01	20.60	47.02	98.43	2.05	0.001
Occurrence 0069						
GpAnR-315	0.03	20.80	46.92	99.38	1.13	0.002
GpAnR-316	<0.01	20.83	46.66	99.53	0.57	0.004
GpAnR-317	<0.01	20.16	45.24	96.33	0.69	0.007
Occurrence 0070						
GpAnR-318	0.01	20.81	46.63	99.43	0.60	0.010
GpAnR-319	<0.01	20.82	46.43	99.38	0.22	0.007
GpAnR-320	<0.01	20.21	45.50	96.56	0.94	0.015
Occurrence 0071						
GpAnR-322	<0.01	20.54	45.87	98.14	0.32	0.005
Occurrence 0072						
GpAnR-323	<0.01	19.74	44.08	94.32	0.31	0.005
Occurrence 0073						
GpAnR-324	<0.01	20.82	46.66	99.48	0.61	0.004
GpAnR-325	<0.01	20.82	46.86	99.48	0.95	0.004
Occurrence 0074						
GpAnR-326	<0.01	20.90	46.79	99.86	0.53	0.005
Occurrence 0075						
GpAnR-335	0.11	20.80	46.83	99.38	0.97	0.005



## Occurrence 0081

GpAnR-361	<0.01	20.70	46.31	98.91	0.47	0.043
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## Occurrence 0082

GpAnR-362	<0.01	20.85	46.67	99.62	0.51	0.062
GpAnR-363	<0.01	20.81	46.56	99.43	0.48	0.010
GpAnR-364	<0.01	19.92	45.42	95.18	1.90	0.009

## Occurrence 0083

GpAnR-367	<0.01	18.43	41.10	88.06	0.19	0.017
GpAnR-369	0.10	20.87	46.46	99.72	0.08	0.022
GpAnR-384	<0.01	20.80	46.79	99.38	0.90	0.008
GpAnR-396	<0.01	9.91	53.38	47.35	53.29	0.011
GpAnR-397	<0.01	20.65	46.24	98.67	0.54	0.018
GpAnR-398	<0.01	20.85	46.48	99.62	0.19	0.013
GpAnR-399	<0.01	4.59	56.11	21.93	78.05	0.021
GpAnR-400	<0.01	20.60	46.19	98.43	0.64	0.014
GpAnR-402	0.03	19.85	44.52	94.84	0.64	0.018

## Occurrence 0084

GpAnR-370	0.08	20.77	46.31	99.24	0.20	0.229
GpAnR-371	0.04	20.84	46.50	99.57	0.26	0.079
GpAnR-372	0.08	8.87	19.80	42.38	0.13	0.024
GpAnR-373	0.08	3.13	54.61	14.96	81.02	0.046
GpAnR-374	0.06	12.91	47.95	61.68	32.71	0.051
GpAnR-375	0.03	20.78	46.63	99.29	0.71	0.012
GpAnR-376	<0.01	20.84	46.64	99.57	0.50	0.120
GpAnR-377	0.08	20.48	46.06	97.85	0.87	0.069
GpAnR-378	0.01	20.46	45.78	97.76	0.47	0.008
GpAnR-379	0.02	19.65	44.65	93.89	1.61	0.007
GpAnR-380	<0.01	18.94	47.00	90.50	8.30	0.007
GpAnR-381	0.03	1.61	57.97	7.69	92.48	0.057

## Occurrence 0085

GpAnR-382	0.02	20.79	46.41	99.34	0.30	0.004
GpAnR-383	0.01	13.79	50.56	65.89	33.82	0.040
GpAnR-385	0.04	20.35	45.67	97.23	0.70	0.005
GpAnR-386	<0.01	20.78	47.42	99.29	0.35	0.007
GpAnR-387	0.04	19.84	44.30	94.80	0.30	0.230
GpAnR-388	<0.01	20.42	45.89	97.57	0.81	0.043





GpAnR-1227	<0.01	0.40	54.85	1.91	82.61	0.018
GpAnR-1228	<0.01	0.61	57.33	2.92	95.18	0.016
GpAnR-1229	<0.01	0.41	56.74	1.96	94.93	0.015
GpAnR-1230	0.05	0.41	46.67	1.96	77.81	0.017
GpAnR-1231	0.04	0.39	54.64	1.86	91.44	0.012
GpAnR-1232	<0.01	0.50	51.50	2.39	85.85	0.015
GpAnR-1233	<0.01	0.63	41.76	3.01	68.63	0.020
GpAnR-1234	0.05	0.90	58.22	4.30	95.59	0.005
GpAnR-1235	0.08	0.59	54.26	2.82	90.03	0.010
GpAnR-1236	0.08	0.59	50.16	2.82	83.06	0.013
GpAnR-1237	<0.01	1.12	55.47	5.35	90.09	0.007
GpAnR-1238	<0.01	1.18	41.21	5.64	65.61	0.010
GpAnR-1239	0.01	20.52	46.27	98.04	1.08	0.007
GpAnR-1240	0.23	20.63	46.44	98.57	0.95	0.007
GpAnR-1241	0.29	20.62	46.83	98.52	1.65	0.004
GpAnR-1242	0.26	20.63	46.76	98.57	1.50	0.004
GpAnR-1243	<0.01	2.10	49.43	10.03	76.11	0.007
GpAnR-1244	<0.01	3.09	55.51	14.76	82.70	0.007
GpAnR-1245	<0.01	0.69	56.37	3.30	93.58	0.011
GpAnR-1246	<0.01	0.80	58.08	3.82	95.73	0.009
GpAnR-1247	<0.01	0.80	58.65	3.82	96.70	0.006
GpAnR-1248	0.03	2.67	55.27	12.76	83.88	0.011
GpAnR-1249	<0.01	0.52	56.29	2.49	93.75	0.008
GpAnR-1250	<0.01	0.55	57.88	2.63	96.34	0.010
GpAnR-1251	0.04	0.55	49.81	2.63	82.62	0.014
GpAnR-1252	<0.01	0.71	54.22	3.39	89.51	0.012
GpAnR-1253	<0.01	0.38	57.10	1.82	95.66	0.010
GpAnR-1254	<0.01	0.42	54.95	2.01	91.85	0.014
GpAnR-1255	<0.01	0.46	57.60	2.20	96.20	0.013
GpAnR-1256	<0.01	0.39	57.17	1.86	95.74	0.010
GpAnR-1257	<0.01	0.92	53.79	4.40	87.99	0.010
GpAnR-1258	<0.01	0.80	55.32	3.82	91.04	0.008
GpAnR-1259	0.01	0.77	56.25	3.68	92.74	0.009
GpAnR-1260	<0.01	0.78	56.81	3.73	93.65	0.010
GpAnR-1261	<0.01	0.79	57.55	3.78	94.87	0.010
GpAnR-1262	0.04	0.75	57.06	3.58	94.19	0.010
GpAnR-1263	0.11	0.62	55.65	2.96	92.28	0.010
GpAnR-1264	0.09	0.72	57.44	3.44	94.95	0.013
GpAnR-1265	0.11	0.74	57.36	3.54	94.74	0.011
GpAnR-1266	<0.01	0.76	55.51	3.63	91.52	0.010
GpAnR-1267	0.03	0.77	56.99	3.68	93.99	0.012



GpAnR-1306	<0.01	0.69	57.57	3.30	95.28	0.008
GpAnR-1307	<0.01	1.53	47.96	7.31	75.77	0.011
GpAnR-1308	0.08	6.64	47.55	31.73	55.74	0.009
Occurrence 0088						
GpAnR-613	0.09	20.02	45.78	95.66	2.14	0.011
GpAnR-614	0.05	5.59	53.83	26.71	70.39	0.009
GpAnR-615	0.11	19.93	45.77	95.23	2.46	0.012
Occurrence 0089						
GpAnR-616	0.05	20.14	45.85	96.23	1.80	0.013
GpAnR-617	0.08	20.18	46.21	96.42	2.26	0.007
GpAnR-618	0.10	12.62	51.18	60.30	39.30	0.017
Occurrence 0091						
GpAnR-405	0.07	20.03	45.40	95.70	1.45	0.016
Occurrence 0092						
GpAnR-406	0.03	20.34	46.26	97.19	1.74	0.006
GpAnR-407	<0.01	6.12	55.30	29.24	70.89	0.007
GpAnR-408	0.04	19.38	47.97	92.60	8.28	0.018
Occurrence 0093						
GpAnR-417	<0.01	17.59	39.44	84.05	0.55	0.290
GpAnR-418	<0.01	20.55	46.01	98.19	0.52	0.109
GpAnR-419	<0.01	20.66	46.62	98.71	1.15	0.032
GpAnR-420	<0.01	20.71	46.43	98.95	0.63	0.150
GpAnR-421	<0.01	20.76	46.45	99.19	0.48	0.105
Occurrence 0094						
GpAnR-422	<0.01	19.30	43.06	92.22	0.23	0.008
GpAnR-423	<0.01	19.83	44.86	94.75	1.29	0.150
GpAnR-424	<0.01	16.36	48.01	78.17	19.77	0.067
GpAnR-425	0.02	14.93	34.26	71.34	1.80	0.033
GpAnR-426	0.04	19.56	44.20	93.46	1.19	0.037
GpAnR-427	0.03	14.71	44.60	70.28	20.21	0.026





<b>Occurrence 0103</b>									
GpAnR-452	0.10	17.26	47.47	82.47	15.45	0.006			
GpAnR-453	0.16	20.32	45.70	97.09	0.87	0.004			
<b>Occurrence 0104</b>									
GpAnR-454	0.11	10.42	50.10	49.79	45.79	0.217			
GpAnR-455	0.06	19.71	44.61	94.17	1.32	0.065			
GpAnR-456	0.09	20.40	45.86	97.47	0.84	0.011			
<b>Occurrence 0105</b>									
GpAnR-457	0.072	0.83	46.70	99.53	0.64	0.012			
GpAnR-458	0.121	9.19	43.56	91.69	1.50	0.010			
GpAnR-459	0.102	0.49	46.35	97.90	1.33	0.008			
GpAnR-460	0.092	0.68	46.37	98.81	0.64	0.010			
<b>Occurrence 0106</b>									
GpAnR-461	0.06	19.73	44.91	94.27	1.75	0.007			
GpAnR-462	0.08	19.95	44.50	95.32	0.23	0.010			
GpAnR-463	0.04	20.39	45.64	97.42	0.50	0.005			
GpAnR-464	0.12	20.81	46.38	99.43	0.17	0.008			
GpAnR-465	0.11	20.89	46.47	99.81	0.04	0.008			
GpAnR-466	0.11	20.67	46.40	98.76	0.73	0.007			
GpAnR-467	0.11	18.94	42.98	90.50	2.65	0.007			
GpAnR-468	0.09	20.14	45.53	96.23	1.26	0.007			
GpAnR-469	0.06	19.79	44.22	94.56	0.35	0.016			
GpAnR-470	0.03	19.82	45.09	94.70	1.72	0.005			
<b>Occurrence 0113</b>									
GpAnR-543	0.09	19.75	45.02	94.37	1.87	0.006			
<b>Occurrence 0115</b>									
GpAnR-470A	<0.01	13.21	50.67	63.12	36.20	0.003			
GpAnR-471	0.07	5.52	54.83	26.38	72.36	0.006			
GpAnR-519	0.05	20.32	46.22	97.09	1.75	0.011			
GpAnR-520	0.04	2.94	55.29	14.05	82.90	0.016			
GpAnR-521	<0.01	20.19	45.17	96.47	0.46	0.014			
GpAnR-522	0.05	16.43	46.72	78.50	17.31	0.008			



GpAnR-491	<0.01	10.83	52.08	51.75	47.60	0.008
GpAnR-492	<0.01	20.14	45.96	96.23	1.99	0.005
GpAnR-493	0.01	7.58	53.57	36.22	62.43	0.003
GpAnR-494	0.03	20.09	45.82	95.99	1.94	0.002
GpAnR-495	<0.01	18.44	42.52	88.11	2.57	0.005
GpAnR-496	<0.01	19.56	44.72	93.46	2.07	0.005
GpAnR-602	<0.01	19.68	44.94	94.03	1.99	0.007
GpAnR-603	0.07	20.29	46.50	96.95	2.35	0.006
GpAnR-604	0.06	20.48	46.52	97.85	1.66	0.007
GpAnR-605	0.05	20.17	46.37	96.37	2.57	0.008
Occurrence 0125						
GpAnR-497	<0.01	19.93	46.37	95.23	3.48	0.006
GpAnR-498	0.04	5.31	55.35	25.37	74.04	0.006
GpAnR-501	<0.01	20.57	47.08	98.28	2.27	0.003
GpAnR-502	0.02	20.48	46.64	97.85	1.86	0.002
Occurrence 0126						
GpAnR-503	0.01	20.44	46.67	97.66	2.06	0.007
GpAnR-504	<0.01	20.44	46.71	97.66	2.13	0.006
Occurrence 0127						
GpAnR-506	0.062	0.49	46.60	97.90	1.75	0.005
GpAnR-507	0.062	0.64	46.79	98.62	1.51	0.008
GpAnR-508	0.042	0.63	46.96	98.57	1.84	0.013
Occurrence 0129						
GpAnR-499	<0.01	15.77	49.11	75.35	23.87	0.008
GpAnR-500	0.03	20.42	46.39	97.57	1.66	0.005
Occurrence 0132						
GpAnR-505	0.08	20.24	45.93	96.71	1.56	0.013
Occurrence 0135						
GpAnR-612	<0.01	20.12	46.21	96.13	2.49	0.008
Occurrence 0138						
GpAnR-548	0.07	20.72	46.65	99.00	0.97	0.012



## Occurrence 0146

GpAnR-509	0.05	20.53	46.71	98.09	1.79	0.014
GpAnR-523	0.17	17.98	41.26	85.91	2.17	0.110
GpAnR-524	0.12	20.13	46.07	96.18	2.21	0.140
GpAnR-525	0.04	20.34	45.97	97.18	1.25	0.005
GpAnR-526A	0.12	19.49	43.51	93.12	0.28	0.110
GpAnR-528	0.01	19.26	43.59	92.02	1.29	0.004
GpAnR-529	0.03	20.48	46.21	97.85	1.13	0.014
GpAnR-546	0.20	20.60	45.90	98.43	0.15	0.061
GpAnR-547	0.09	20.25	45.68	96.75	1.10	0.067
GpAnR-567	0.19	19.91	44.98	95.13	1.19	0.030
GpAnR-568	<0.01	16.72	37.66	79.89	0.81	0.014
GpAnR-569	<0.01	19.78	45.00	94.51	1.72	0.012
GpAnR-581	0.03	19.59	44.98	93.60	2.40	0.004
GpAnR-582	0.24	19.73	44.10	94.27	0.38	0.014

## Occurrence 0147

GpAnR-530	0.04	19.25	43.60	91.98	1.34	0.063
GpAnR-531	0.05	19.62	43.98	93.74	0.59	0.031
GpAnR-532	0.05	20.28	45.53	96.90	0.73	0.019
GpAnR-533	0.08	19.86	44.89	94.89	1.23	0.013
GpAnR-534	0.09	19.36	44.35	92.50	2.20	0.079
GpAnR-535	0.02	20.23	45.60	96.66	1.04	0.090
GpAnR-536	0.56	20.40	45.49	97.47	0.21	0.210
GpAnR-537	0.05	20.14	45.48	96.23	1.17	0.029
GpAnR-538	0.05	20.31	46.32	97.04	1.96	0.061
GpAnR-539	0.08	1.39	57.58	6.64	92.65	0.051
GpAnR-540	0.05	19.60	44.36	93.65	1.31	0.078
GpAnR-541	0.07	19.46	44.33	92.98	1.79	0.052
GpAnR-542	0.10	1.865	3.77	8.89	84.40	0.120

## Occurrence 0148

GpAnR-587	<0.01	11.96	50.41	57.14	40.49	0.004
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## Occurrence 0149

GpAnR-526	0.01	20.52	46.50	98.04	1.47	0.011
GpAnR-527	0.01	20.55	46.21	98.19	0.86	0.011





GpAnR-591	<0.01	20.43	46.47	97.61	1.76	0.007
GpAnR-592	0.10	20.56	46.48	98.24	1.28	0.006
GpAnR-597	0.02	20.36	46.39	97.28	1.89	0.010
GpAnR-598	<0.01	19.93	46.12	95.23	3.06	0.009
GpAnR-599	0.05	20.39	46.48	97.42	1.93	0.008
Occurrence 0178						
GpAnR-611	0.03	20.08	46.01	95.94	2.30	0.010



**APPENDIX 4.**  
**DRILL LOGS OF PREVIOUSLY COMPLETED DRILLHOLES**  
**WHICH WERE SAMPLED**  
**THAT PERTAIN TO SPECIFIC OCCURRENCES**  
**ORDERED BY REFERENCE NUMBER**





**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

<b>Property:</b>	Meadows Road, Occurrence 0001	<b>Azimuth:</b>	
<b>Hole Number:</b>	MR-86-1	<b>Dip:</b>	90°
<b>Latitude:</b>	46°00'38.87"	<b>Started:</b>	July 10, 1986
<b>Longitude:</b>	60°15'44.86"	<b>Completed:</b>	July 23, 1986
<b>Elevation:</b>	82.946 m	<b>Ultimate Depth:</b>	125.27 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-38.71	Overburden, granitic and metamorphic clasts, mud above contact.					
38.71-53.25	Siltstone, moderate to dark reddish brown mottled greenish grey in part; sandy near top decreases below, blocky to rubbly in mid unit to base with mud filled cavities in lower portion. Contact rubbly and uncertain.					
53.25-59.80	Gypsum, white, massive to nodular mosaic with varying amounts of interstitial dolostone possible minor portions of anhydrite. Grade +80%. Contact is erosional.	R-1008	53.69-53.95	85.43	0.47	0.010
		R-1009	57.23-57.53	84.95	0.69	0.009
59.80-60.02	?Hemihydrate, light grey, very fine grained, dense, minor fine grained gypsum filled fractures. Contact is erosional.					
60.02-62.64	Gypsum, white, fine grained, massive to nodular mosaic, minor interstitial dolostone. Grade +85%. Contact erosional.	R-1010	60.93-61.16	95.94	1.50	0.005
		R-1011	62.65-62.89	88.01	0.67	0.008
62.64-62.88	?Hemihydrate, as above. Contact erosional.					
62.88-63.79	Gypsum, white massive, as above.					
63.79-64.01	?Hemihydrate, as above.					
64.01-64.28	Gypsum, white massive, as above.					
64.28-64.50	?Hemihydrate, as above, with 3 cm mud filled cavity at base. Contact erosional.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
64.50-65.32	Gypsum, white, massive, vuggy in mid unit with selenitic gypsum in vugs. Contact erosional.					
65.32-65.59	?Hemihydrate, as above. Contact erosional.					
65.59-76.20	Gypsum, white, fine grained, nodular mosaic to massive, 1.5 m core missing around 75.29 m, probable solution cavity at basal contact. Few minor dolomitic interlaminae base. Contact erosional.	R-1012	64.59-64.80	87.58	0.91	0.009
		R-1013	67.19-67.44	97.85	0.13	0.003
		R-1014	70.74-71.02	98.33	0.17	0.006
		R-1015	73.53-73.76	96.13	1.01	0.006
76.20-81.38	Limestone, medium to dark grey, massive to rubbly, highly calcareous abundant brachiopod fossils, sandy at base. Contact ?.					
81.38-84.43	No core recovered.					
84.43-86.47	Sandstone, medium to light grey, conglomeratic at top, calcareous at top grades to siltstone below, colour grades to red. Contact gradational.					
86.47-92.42	Siltstone, dark reddish brown, sandy at top, minor satin spar filled fractures parallel to bedding 80-85° to core axis. Contact erosional.					
92.42-93.67	Siltstone, light greyish green, minor satin spar filled fractures. Contact gradational.					
93.67-100.10	Siltstone, dark reddish brown, as above. Contact erosional.					
100.10-112.38	Gypsum, white to light grey, massive to nodular at base, increasing interstitial limestone towards base. Grades 85% at top, 50% at base. Contact gradational.	R-1016	101.15-101.47	79.12	1.72	0.026
		R-1017	104.44-104.80	79.75	0.67	0.009
		R-1018	107.52-107.87	79.75	0.73	0.008
		R-1019	111.40-111.68	82.28	2.74	0.005
112.38-124.05	Limestone, light brown at top grades to medium to dark grey at base, variably calcareous and fossiliferous, massive to 121.62 m blocky below, rubbly contact.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
124.05-125.27	Siltstone, medium reddish brown, sandy in part, blocky with some core missing.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: G. Adams

Property: Meadows Road, Occurrence 0001      Azimuth:  
Hole Number: MR-86-2      Dip: 90°  
Latitude: 46°00'35.11"      Started: July 24, 1986  
Longitude: 60°15'48.52"      Completed: July 31, 1986  
Elevation: 84.086 cm      Ultimate Depth: 111.86 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-41.76	Overburden.					
41.76-58.45	Siltstone, dark reddish brown, slumped material with abundant red clay infilling, rubbly at base.					
58.45-63.40	Limestone, medium to dark grey, calcareous, vuggy at top, very fossiliferous, +1.5 m core missing, rubbly in part. Contact gradational.					
63.40-69.19	Conglomerate, grades to sandstone, calcareous at top, light grey grades to red, +1.5 m core missing. Contact gradational.					
69.19-81.69	Siltstone, dark reddish brown, minor grey clay interbeds, laminae 80° to core axis. Contact erosional.					
81.69-92.42	Gypsum, white to light grey, nodular with abundant interstitial limestone and dolostone (base), abundant selenite towards base, 3 cm satin spar veinlet at base. Contact erosional.	R-1005	81.76-82.37	77.69	0.69	0.007
		R-1006	85.28-85.55	75.88	1.04	0.009
		R-1007	91.64-91.95	84.00	1.66	0.008

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
92.42-107.29	Limestone, light brown at top, medium to dark grey below, dolomitic at top to calcareous at bottom, lower half blocky to rubbly with much core missing, mud filled cavity at base.					
107.29-111.86	Siltstone, reddish brown, in part conglomeratic mostly missing.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: G. Adams

Property:	Meadows Road, Occurrence 0001	Azimuth:	
Hole Number:	MR-86-3	Dip:	90°
Latitude:	46°10'2.04'	Started:	August 1, 1986
Longitude:	60°16'26.72'	Completed:	August 12, 1986
Elevation:	48.426 m	Ultimate Depth:	84.43 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-18.90	Overburden.					
18.90-28.35	Solution cavity, blocks of light brown limestone and white, nodular mosaic gypsum with red clay infilling.	R-1000		93.94	1.90	0.005
28.35-54.86	Siltstone, medium to dark reddish brown with light grey-green mottling, variably sandy and shaly and very minor conglomeratic interbed, laminae 80° to core axis, 53.34-53.80 m fracture filled with orange selenite. Contact erosional.					
54.86-55.90	Gypsum, light grey to orange, selenitic with dolomitic laminae at base. Contact is gradational.	R-1001	54.86-55.68	94.70	1.74	0.023
55.90-63.09	Anhydrite, light blue, massive with very minor interstitial dolostone and gypsum rosettes. Contact erosional.	R-1002 R-1003	56.08-56.39 62.79-63.09	7.74 6.12	82.94 73.38	0.023 0.026

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
63.09-63.67	Limestone, light brown with grey limestone interlaminae 85° to core axis. Contact gradational.					
63.67-66.35	Anhydrite, light blue, as above. Contact erosional.	R-1004	66.14-66.35	7.26	89.99	0.020
66.35-66.54	Limestone, light brown, medium grained, laminae 85° to core axis, sandy at base. Contact gradational.					
66.54-84.43	Sandstone, light grey at top to medium to dark reddish brown at bottom, conglomeratic throughout, laminae 80° to core axis. Satin spar filled fractures more abundant toward base.					
End of Hole.						

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: G. Adams

Property: Meadows Road, Occurrence 0001  
 Hole Number: MR-86-4  
 Latitude: 46°01'4.94"  
 Longitude: 60°16'22.66"  
 Elevation: 48.026 m

Azimuth:  
 Dip: 90°  
 Started: August 13, 1986  
 Completed: August 18, 1986  
 Ultimate Depth: 90.53 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-17.37	Overburden.					
17.37-29.35	Limestone, light brown to light grey, rubbly with much core missing, some clay infilling, algal structures near base. Contact is erosional.					
29.35-34.44	Gypsum, white, massive mosaic to nodular mosaic with minor interstitial dolostone, vague dolomitic laminae at base, minor selenite in mid unit, grades +90%. Contact is erosional.	R-1024	29.41-29.69	98.24	2.31	0.006
		R-1025	31.84-32.10	97.19	2.69	0.007
		R-1026	33.91-34.21	92.55	2.32	0.008



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
34.44-37.61	Siltstone, light grey green at top to dark reddish brown at base, abundant satin spar filled fractures throughout, minor calcite along fractures. Contact erosional.					
37.61-45.54	Anhydrite, light blue, 25% gypsum most at top and base with some rosettes throughout, minor interstitial dolostone. Sandy at base.	R-1020	37.64-37.90	98.43	0.13	0.013
		R-1021	40.84-41.10	5.73	90.87	0.016
		R-1022	43.42-43.71	3.92	72.14	0.024
		R-1023	45.11-45.31	5.07	92.34	0.015
45.54-68.46	Sandstone, medium reddish brown except at top where light grey, several fining upwards cycles minor satin spar filled fractures, silty in mid unit and at base. Contact gradational.					
68.46-72.09	Siltstone, dark reddish brown mottled green, abundant satin spar filled fractures and selenite filled vugs. Contact erosional.					
72.09-80.19	Anhydrite, light blue, massive, hydrated zone 9 cm thick at top, minor siltstone interbeds near top. Contact erosional.	R-1027	72.24-72.52	20.64	73.73	0.017
		R-1028	75.36-75.64	5.73	89.36	0.012
		R-1029	78.84-79.15	4.97	90.90	0.011
80.19-80.77	Limestone, light grey, broken at top, minor dark grey siltstone interlaminae 80° to core axis. Contact gradational.					
80.77-83.36	Anhydrite, as above.	R-1030	80.76-81.08	4.30	65.67	0.035
		R-1031	82.98-83.21	3.54	88.26	0.012
83.36-83.67	Limestone, light olive grey, silty at top, sandy at base, minor algal material, laminae 80° to core axis. Contact gradational.					
83.67-90.53	Sandstone, grey green at top, variably silty conglomeratic, calcareous polymictic orthoconglomerate with granitic and metamorphic clasts.					
End of Hole.						

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: G. Adams

Property: Meadows Road, Occurrence 0001  
 Hole Number: MR-86-5  
 Latitude: 46°01'26.64"  
 Longitude: 60°17'47.23"  
 Elevation: 16.486 m

Azimuth:  
 Dip: 90°  
 Started: August 22, 1986  
 Completed: August 22, 1986  
 Ultimate Depth: 38.71 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-38.71	Overburden and clay filled karst topography. Abandoned hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: G. Adams

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Property: Meadows Road, Occurrence 0001  
 Hole Number: MR-86-6  
 Latitude: 46°01'31.79"  
 Longitude: 60°17'46.83"  
 Elevation: 16.196 m

Azimuth:  
 Dip: 90°  
 Started: August 25, 1986  
 Completed: August 27, 1986  
 Ultimate Depth: 44.81 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-44.81	Overburden and solution cavity. Abandoned hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: G. Adams

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Property: Meadows Road, Occurrence 0001  
 Hole Number: MR-86-7  
 Latitude: 46°01'47.59"  
 Longitude: 60°20'11.52"  
 Elevation: 4.806

Azimuth:  
 Dip:  
 Started: August 28, 1986  
 Completed: September 5, 1986  
 Ultimate Depth: 84.43 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-15.70	Overburden.					
15.70-16.00	Gypsum, light grey to white, nodular to nodular mosaic, abundant interstitial dolostone, laminae oriented parallel to core axis and minor interlaminae of siltstone 85° to core axis. Contact erosional.	R-1032	15.83-16.11	76.88	1.42	0.003
16.00-16.37	Gypsum, light grey, interlaminated gypsum and limestone/dolostone with abundant gypsum nodules. Contact erosional.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
16.37-16.52	Gypsum, as above, with laminae parallel to core axis. Contact erosional.					
16.52-16.61	Gypsum, light grey, nodular mosaic with common interstitial dolostone and limestone dolostone laminae at base. Contact erosional.					
16.61-16.82	Gypsum, light grey, with vague dolomitic interlaminae 80-85° to core axis minor selenite rosettes. Contact erosional.					
16.82-16.95	Gypsum, white to light grey, nodular mosaic with minor interstitial dolostone and dolostone laminae. Contact erosional.					
16.95-17.22	Gypsum, light grey, vague dolomitic interlaminae 80-85° to core axis. Contact erosional.					
17.22-17.37	Gypsum, white, nodular mosaic with abundant interstitial dolostone, minor limestone interbed near top of unit. Contact erosional.					
17.37-17.65	Gypsum, light grey, vague dolomitic interlaminae. Contact gradational.					
17.65-18.23	Gypsum, white, nodular mosaic with minor to abundant interstitial dolostone medium grained. Contact erosional.					
18.23-18.90	Gypsum, white interlaminae, as above. Contact erosional.	R-1033	18.59-18.95	92.79	2.57	0.005
18.90-19.03	Gypsum, white, nodular mosaic. Contact erosional.					
19.03-19.07	Limestone, medium to dark grey, fine grained, moderately calcareous. Contact erosional.					
19.07-19.17	Gypsum, light grey, vague laminae of dolostone, minor selenite crystals. Contact erosional.					
19.17-19.25	Limestone, as above. Contact erosional.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
19.25-19.66	Gypsum, white nodular mosaic with minor interstitial dolostone. Contact erosional.					
19.66-19.72	Limestone, medium grey, abundant satin spar filled fractures. Contact erosional.					
19.72-20.76	Gypsum, white, nodular mosaic, minor interstitial dolostone, minor selenite crystals near top and base. Contact erosional.					
20.76-20.77	Limestone, medium to dark grey, massive, medium to fine grained. Contact ?.					
20.77-22.86	Gypsum, white to light grey, nodular mosaic with minor interstitial dolostone, numerous small voids near base, anhydrite at base. Contact gradational.	R-1034	21.93-22.15	94.80	2.48	0.006
22.86-39.72	Anhydrite, light blue, nodular mosaic at top with minor interstitial dolostone, rest is massive, minor gypsum filled fractures mostly perpendicular to core axis, minor gypsum rosettes. Contact erosional.	R-1035	24.77-25.02	3.01	91.17	0.039
		R-1036	27.83-28.04	2.34	96.75	0.020
		R-1037	30.65-30.94	4.35	95.20	0.129
		R-1038	33.68-33.96	2.53	97.66	0.015
		R-1039	36.58-36.88	1.82	97.65	0.017
		R-1040	39.52-39.80	2.63	90.12	0.059
39.72-39.81	Limestone, medium to dark grey, massive, as above. Contact erosional.					
39.81-40.51	Anhydrite, light blue, massive with minor gypsum rosettes. Contact erosional.					
40.51-40.58	Limestone, medium to dark grey, fine grained, dense, moderately calcareous, dolomitic in part. Contact erosional.					
40.58-40.81	Anhydrite, light blue, as above. Contact erosional.					
40.81-40.87	Limestone/dolostone medium to dark grey, medium grained, calcareous at top and bottom, vertical gypsum filled fractures. Contact erosional.					
40.87-40.93	Anhydrite, light blue, as above. Contact erosional.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
40.93-41.00	Limestone/dolostone, as above. Contact erosional.					
41.00-41.94	Anhydrite, light blue, minor interstitial limestone, common gypsum rosettes in lower half of unit. Contact erosional.					
41.94-41.96	Dolostone, dark grey, as above. Contact erosional.					
41.96-42.37	Anhydrite, light blue, massive with minor gypsum rosettes. Contact erosional.	R-1041	42.37-42.62	7.17	85.32	0.067
42.37-42.40	Dolostone, dark grey, as above. Contact erosional.					
42.40-44.50	Anhydrite, light blue grey, massive at top to nodular mosaic and nodular below, minor to abundant interstitial limestone, abundant selenite throughout. Contact erosional.	R-1042	44.35-44.60	63.26	2.05	0.014
44.50-44.53	Dolostone, dark grey, fine grained, massive, as above. Contact erosional.					
44.53-47.66	Limestone, light grey to light brownish grey, algal in part, variably fossiliferous with crinoidal material, minor anhydrite at top and gypsum filled fractures throughout. Contact erosional.					
47.66-48.13	Gypsum, white, saccharoidal varying amounts of interstitial dolostone and limestone most common at top and base of unit. Contact erosional.					
48.13-48.52	Mudstone, medium to dark grey, silty in part with silty laminae 75-80° to core axis, minor satin spar filled fractures throughout 60-90° to core axis. Contact ?.					
48.52-48.65	Anhydrite breccia, light blue subrounded anhydrite clasts in medium grey mudstone matrix gypsum at base. Contact erosional.					



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
48.65-49.15	Mudstone, medium grey mottled dark red, gypsum filled fractures at top. Contact gradational.					
49.15-49.29	Anhydrite breccia, as above. Contact gradational.					
49.29-49.74	Mudstone, dark red massive, slightly silty with gypsum and salt filled fractures. Contact erosional.					
49.74-49.80	Anhydrite, light blue, massive nodules in red mudstone matrix. Contact gradational.					
49.80-51.45	Mudstone/siltstone, dark reddish brown, minor sandy interval in mid unit, gypsum filled fractures throughout. Contact gradational.					
51.45-52.00	Anhydrite breccia, as above. Contact erosional.					
52.00-53.95	Mudstone, dark red mottled grey green at base, variably silty, silty at base, gypsum filled fractures throughout. Contact gradational.					
53.95-54.74	Interlaminated mudstone, dolostone and anhydrite, medium to dark grey, 80-85° to core axis. Contact gradational.					
54.74-55.78	Mudstone, dark reddish brown with grey-green mottling and interlaminae. Contact gradational.					
55.78-56.27	Anhydrite breccia, as above, more anhydrite towards base. Contact gradational.					
56.27-79.61	Anhydrite, light blue, massive to nodular downwards with increasing interstitial mudstone, minor dark grey mudstone interbeds near base. Contact erosional.	R-1043	56.66-56.92	4.92	69.24	0.162
		R-1044	59.74-60.05	32.40	65.26	0.071
		R-1045	62.74-63.09	3.78	94.28	0.019
		R-1046	65.70-65.99	2.53	97.32	0.015
		R-1047	68.66-68.99	2.92	96.89	0.021
		R-1048	71.63-71.91	4.30	94.59	0.065
		R-1049	74.60-74.85	5.73	87.85	0.047
		R-1050	77.56-77.82	7.74	74.37	0.284
		R-1051	79.71-79.96	7.65	47.07	0.119

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
79.61-84.43	Shale, dark grey, varies to limestone/dolostone in part, slightly petroliferous, minor fossils.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: G. Adams

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Property:	Meadows Road, Occurrence 0001	Azimuth:	
Hole Number:	MR-86-8	Dip:	90°
Latitude:	46°01'15.95'	Started:	September 8, 1986
Longitude:	60°18'33.78'	Completed:	September 11, 1986
Elevation:	23.956 cm	Ultimate Depth:	67.36 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-10.06	Overburden.					
10.06-11.28	Limestone, dark grey, highly calcareous, medium grained, scoriaceous in part, minor laminae 50° to core axis, cavity at base at contact with gypsum.					
11.28-23.47	Gypsum, white, massive to nodular mosaic much more missing at top and bottom probably solution cavities. Contact missing.	R-1055 R-1056	14.33-14.58 19.91-20.19	98.95 93.41	0.89 0.70	0.003 0.005
23.47-26.52	Siltstone, dark reddish brown, minor sandy material, minor calcite filled fractures, slightly calcareous in mid unit, 0.46 m core missing.					
26.52-32.61	Siltstone, dark reddish brown, calcareous only 1.7 m core, variably sandy increasing towards base. Contact ?.					
32.61-38.40	Mudstone breccia, dark reddish brown poorly consolidated, calcareous, possible solution cavity infilling. Contact ?.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
38.40-41.76	Gypsum, white, massive to nodular, only 2.13 m core recovered, probably cavity at base, minor to common interstitial calcareous mudstone. Contact ?.	R-1057	38.48-38.71	95.75	2.06	0.004
		R-1058	41.32-41.63	91.55	2.58	0.007
41.76-57.00	Cavity, only 0.91 m core recovered, minor limestone and sandy siltstone recovered.					
57.00-61.72	Siltstone, dark reddish brown, sandy to conglomeratic in part with poorly sorted polymictic clasts (quartz, red and green siltstone and metamorphics), highly calcareous throughout. Only 1.2 m core recovered in top 3.0 m of unit. Cavity at base.					
61.72-66.32	Siltstone, dark reddish brown, sandy, scoriaceous, minor conglomeratic interbed in mid unit, shaly towards base. Contact gradational.					
66.32-67.36	Siltstone and shale interlaminated, dark reddish brown with minor grey mottling, laminae 80-85° to core axis.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: G. Adams

**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

<b>Property:</b>	Mount Denson, Occurrence 0005	<b>Azimuth:</b>	
<b>Hole Number:</b>	1/305 A	<b>Dip:</b>	
<b>Latitude:</b>	Not Available	<b>Started:</b>	
<b>Longitude:</b>	Not Available	<b>Completed:</b>	
<b>Elevation:</b>	37 m	<b>Ultimate Depth:</b>	192 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-57.91	Overburden.					
57.91-93.20	Gypsum, white to grey white, variable interstitial to inter-laminated dark grey dolostone, grades to anhydrite in part.	R-1512	58.37-58.65	98.52	0.11	0.007
		R-1513	60.96-61.22	99.19	0.87	0.006
		R-1514	62.41-62.71	99.81	0.48	0.005
		R-1515	63.73-64.01	99.38	0.70	0.006
		R-1516	65.40-65.71	99.91	0.66	0.004
		R-1517	66.70-67.06	93.65	7.30	0.005
		R-1518	68.15-68.45	99.00	0.82	0.005
		R-1519	69.67-70.00	84.95	15.83	0.006
		R-1520	71.22-71.53	53.85	46.33	0.002
		R-1521	72.57-72.95	45.73	54.61	0.004
		R-1522	74.17-74.47	94.37	5.61	0.005
		R-1523	75.67-75.94	82.13	14.91	0.008
		R-1524	77.09-77.37	80.03	17.26	0.005
		R-1525	78.46-78.79	31.34	69.19	0.006
		R-1526	79.86-80.14	92.22	7.58	0.005
		R-1527	81.00-81.31	73.77	24.92	0.008
		R-1528	82.75-83.08	75.06	24.12	0.010
		R-1529	84.20-84.31	97.52	1.22	0.009
		R-1530	85.80-86.08	97.71	1.77	0.015
		R-1531	87.30-87.58	86.39	12.79	0.009
		R-1532	88.72-89.05	98.33	0.80	0.006
		R-1533	92.48-92.84	96.90	0.92	0.008
93.20-99.60	Cavity, partially infilled by muddy limestone, dark grey.					
99.60-102.30	Sandstone, medium grey, medium grained, calcareous.					
102.30-192.00	Interbedded sandstones and siltstones of the Cheverie Formation.					
	End of Hole.					

Drilling Performed By: Maritime Diamond Drilling

Geologist: G. Adams

**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

<b>Property:</b>	Upper Falmouth, Occurrence 0007	<b>Azimuth:</b>				
<b>Hole Number:</b>	1/309	<b>Dip:</b>				
<b>Latitude:</b>	Not Available	<b>Started:</b>				
<b>Longitude:</b>	Not Available	<b>Completed:</b>				
<b>Elevation:</b>	15 m	<b>Ultimate Depth:</b>	156.60 m			
Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-21.64	Overburden.					
21.64-22.51	Anhydrite, light blue, minor to common gypsum along fractures.	R-1597	21.64-21.97	15.10	83.14	0.012
22.51-23.16	Gypsum, brownish white, distorted nodular, minor interstitial black limestone.	R-1598	22.53-22.94	98.05	0.54	0.009
23.16-23.73	Anhydrite, light grey, common hydration along fractures perpendicular to core axis.					
23.73-71.70	Anhydrite, light blue, massive, minor interstitial grey-brown limestone.	R-1599	24.03-24.38	3.15	95.36	0.013
		R-1600	26.97-27.28	1.96	97.80	0.019
		R-1601	30.07-30.38	1.63	96.28	0.014
		R-1602	32.97-33.25	1.82	96.64	0.013
		R-1603	34.90-35.18	3.11	95.81	0.015
		R-1604	37.77-38.08	3.30	93.17	0.012
		R-1605	40.74-41.07	2.44	97.05	0.014
		R-1606	43.64-43.97	3.06	95.88	0.016
		R-1607	46.53-46.84	2.68	90.78	0.013
		R-1608	49.51-49.78	2.49	96.08	0.006
		R-1609	52.45-52.78	3.44	90.87	0.014
		R-1610	55.37-55.65	3.01	94.00	0.015
		R-1611	58.24-58.55	2.15	93.20	0.015
		R-1612	61.19-61.47	3.78	92.78	0.015
		R-1613	64.16-64.47	2.69	93.58	0.011
		R-1614	67.06-67.31	2.68	94.30	0.010
		R-1615	70.10-70.41	2.4	97.05	0.013
71.70-72.54	Anhydrite, light blue, massive with numerous fractures with recrystallized anhydrite parallel to core axis.					
72.54-81.48	Anhydrite, light blue, massive, minor interstitial grey-brown limestone.	R-1616	73.15-73.43	3.68	95.44	0.014
		R-1617	76.28-76.50	3.01	95.14	0.012
		R-1618	79.25-79.55	3.25	94.88	0.012
81.48-82.07	Anhydrite, light blue, massive with dark grey limestone interbeds 90° to core axis at base of unit.					



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
82.07-82.30	Limestone, medium grey to grey brown, organic stringers 60-70° to core axis.					
82.30-94.49	Anhydrite, light blue, massive, minor patches of interstitial light brown limestone increasing towards base.	R-1619	82.60-82.55	4.16	88.75	0.013
		R-1620	85.34-85.67	3.15	96.71	0.013
		R-1621	88.39-88.70	3.25	90.91	0.017
		R-1622	91.44-91.74	0.86	97.64	0.015
		R-1623	94.21-94.49	0.91	98.40	0.013
94.49-95.20	Limestone, medium grey, abundant gypsum/anhydrite patches at top and base.					
95.20-102.11	Anhydrite, light blue, massive, minor interstitial light brown limestone.	R-1624	97.26-97.54	0.96	97.22	0.013
		R-1625	100.28-100.58	1.58	97.92	0.011
		R-1626	101.86-103.11	1.15	95.11	0.011
102.11-103.00	Gypsum, light grey, abundant dolostone/limestone patches and stringers.					
103.00-103.30	Dolostone, medium grey, massive, rubbly, cut by satin spar filled fractures.					
103.30-104.30	Gypsum, as above.					
104.30-105.60	Dolostone, as above.					
105.60-156.60	Interbedded sandstones and siltstones of the Cheverie Formation and sandstone and shales of the Horton Bluff Formation.					
	End of Hole.					

Drilling Performed By: Maritime Diamond Drilling

Geologist: G. Adams

**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

Property: Three Mile Plains, Occurrence 0009      Azimuth:  
Hole Number: 1/306      Dip:  
Latitude: Not Available      Started:  
Longitude: Not Available      Completed:  
Elevation:      Ultimate Depth: 304 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-8.23	Overburden.					
8.23-22.86	Anhydrite, blue grey, massive with several thin fractures 90° to core axis infilled by grey gypsum.	R-1534	8.23-8.53	10.27	88.55	0.010
		R-1535	11.28-11.58	2.25	96.46	0.011
		R-1536	14.07-14.40	2.10	98.82	0.014
		R-1537	16.92-17.20	1.63	95.82	0.009
		R-1538	19.38-20.17	4.01	94.46	0.008
22.86-60.96	Anhydrite, blue grey, massive, minor gypsum filled fractures 20° to core axis.	R-1539	22.81-23.06	3.06	95.83	0.012
		R-1540	24.38-24.69	2.58	95.88	0.016
		R-1541	27.46-27.79	2.82	96.00	0.009
		R-1542	30.48-30.81	2.63	95.51	0.006
		R-1543	33.17-33.48	2.25	96.05	0.006
		R-1544	36.04-36.32	2.29	96.67	0.007
		R-1545	38.91-39.19	2.01	95.98	0.009
		R-1546	41.93-42.27	6.31	90.27	0.013
		R-1547	46.18-46.48	3.20	96.18	0.012
		R-1548	49.10-49.40	4.11	93.82	0.008
		R-1549	52.12-52.40	3.06	94.83	0.010
		R-1550	54.86-55.17	3.35	94.50	0.010
		R-1551	48.01-48.32	2.53	96.42	0.012
60.96-68.58	Anhydrite, blue grey, massive, gypsum filled fractures 90° to core axis.	R-1552	60.96-61.29	4.30	93.93	0.011
		R-1553	63.65-63.93	3.20	94.10	0.011
		R-1554	67.06-67.36	2.96	93.41	0.012
68.58-68.99	Anhydrite, as above, contains 30 mm long selenite crystals.					
68.99-82.81	Anhydrite, blue grey, massive, minor interstitial dolostone.	R-1555	70.10-70.36	2.72	93.83	0.013
		R-1556	73.15-73.41	2.68	91.85	0.013
		R-1557	76.20-76.48	2.06	95.33	0.009
		R-1558	79.25-79.50	1.86	98.25	0.012
		R-1559	82.30-82.58	2.49	97.35	0.012
82.81-82.86	Cavity infilled by mottled grey calcareous mudstone.					
82.86-83.95	Anhydrite, light blue, massive, cut by numerous gypsum filled fractures 90° to core axis.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
83.95-101.12	Anhydrite, light blue, massive minor interstitial limestone.	R-1560	85.12-85.42	2.01	97.32	0.012
		R-1561	88.01-88.37	2.25	97.27	0.013
		R-1562	91.01-91.34	3.30	96.25	0.023
		R-1563	93.88-94.23	2.44	96.19	0.064
		R-1564	96.98-97.28	2.25	95.09	0.011
		R-1565	99.87-100.20	2.20	90.76	0.015
		R-1566	100.76-101.07	7.31	74.73	0.016
101.12-101.57	Limestone, medium grey, fossiliferous with crinoid stems, laminae 70° to core axis.					
101.57-159.11	Anhydrite, blue grey, massive, <5% interstitial dolostone, minor gypsum rosettes.	R-1567	103.35-103.61	3.11	95.62	0.010
		R-1568	106.40-106.68	3.11	96.37	0.010
		R-1569	109.42-109.73	1.82	97.37	0.011
		R-1570	112.47-112.78	1.91	96.14	0.008
		R-1571	115.37-115.70	1.67	95.89	0.007
		R-1572	118.57-118.87	1.48	97.66	0.008
		R-1573	121.39-121.66	1.15	98.33	0.008
		R-1574	124.54-124.87	1.48	97.88	0.007
		R-1575	127.69-128.02	2.06	97.85	0.010
		R-1576	130.63-130.96	2.29	97.45	0.010
		R-1577	133.78-134.09	1.63	98.07	0.008
		R-1578	136.70-136.98	3.25	96.34	0.009
		R-1579	137.18-137.44	1.53	97.67	0.010
		R-1580	140.21-140.46	4.73	94.01	0.009
		R-1581	143.26-143.56	2.10	97.73	0.008
		R-1582	146.30-146.58	2.77	94.49	0.011
		R-1583	149.05-149.35	7.36	91.42	0.006
		R-1584	152.10-152.40	2.96	96.01	0.010
		R-1585	155.09-155.35	3.63	95.41	0.011
		R-1586	157.48-157.79	4.54	94.32	0.013
		R-1587	158.80-159.11	2.63	92.69	0.009
159.11-160.32	Interbedded and interlaminated dolostone and light grey gypsum.					
160.32-169.26	Anhydrite, blue grey, massive, minor to common interstitial grey silt and grey-brown limestone.	R-1588	161.64-161.93	6.93	89.98	0.009
		R-1589	163.73-164.01	14.48	84.43	0.007
		R-1590	165.38-165.71	52.75	46.60	0.005
		R-1591	167.13-167.46	14.38	85.54	0.006
169.26-173.99	Mudstone/gypsum intermixed grey calcareous mudstone with abundant satin spar filled fractures.	R-1592	171.83-172.14	92.65	1.90	0.005
		R-1593	173.41-173.74	95.80	1.09	0.006
173.99-174.75	Dolostone, light grey brown, thin gypsum filled fractures, minor organics.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
174.75-177.80	Gypsum, selenite for most part, abundant interstitial grey limestone in part.	R-1594	174.75-175.06	99.38	0.75	0.004
		R-1595	176.43-176.76	98.81	1.15	0.005
		R-1596	177.42-177.67	97.23	0.31	0.005
177.80-179.90	Limestone, grey green, laminated 80-85° to core axis, rubbly at base.					
179.90-277.00	Interbedded, siltstones and sandstones of the Cheverie Formation.					
277.00-299.50	Interbedded and interlaminated shales and sandstones of the Horton Bluff Formation.					
299.50-304.00	Meguma Basement.					
	End of Hole.					

Drilling Performed By: Maritime Diamond Drilling

Geologist: G. Adams

**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

**Property:** Dundee, Occurrence 0014  
**Hole Number:** KC-BR-2  
**Latitude:** 45°41'33"  
**Longitude:** 61°07'26"  
**Elevation:**

**Azimuth:**  
**Dip:**  
**Started:**  
**Completed:**  
**Ultimate Depth:** 93.88 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-4.75	Overburden.					
4.75-5.79	Gypsum, white, dense, fine grained, minor interstitial black siltstone.					
5.79-6.71	Cavity, minor gypsum fragments.					
6.71-7.28	Gypsum, white, as above.					
7.28-7.41	Cavity, infilled by light grey-green mudstone.					
7.41-7.77	Gypsum, white, saccharoidal.					
7.77-8.05	Cavity, infilled, as above.					
8.05-8.78	Gypsum, white, as above, with common interstitial black calcareous siltstone.					
8.78-9.20	Cavity, infilled by grey-green mudstone with gypsum clasts.					
9.20-10.42	Gypsum, white, 60% fine grained, 30% satin spar, 10% selenitic minor interstitial black limestone.					
10.42-12.13	Cavity, infilled by grey-green to reddish-brown siltstone/mudstone.					
12.13-12.28	Gypsum, white 50% fine grained, 50% satin spar.					
12.28-14.72	Anhydrite, light grey, massive, dense.					
14.72-15.54	Anhydrite, white, gypsiferous, common interstitial black dirty dolostone.					
15.54-16.82	Gypsum, white, slightly anhydritic, common interstitial black dolostone.					
16.82-17.04	Dolostone.					



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
17.04-18.90	Mudstone, medium grey green, gypsiferous.					
18.90-20.21	Collapse breccia, grey-green sandstone and siltstone clasts in red, grey-green mudstone matrix.					
20.21-20.39	Gypsum, white, fine grained dense.					
20.39-21.58	Collapse breccia, as above.					
21.58-22.34	Gypsum, white, 50% satin spar, 50% fine grained.	R-1455	21.79-22.15	98.05	2.0	0.006
22.34-22.80	Collapse breccia, reddish brown, as above.					
22.80-23.50	Gypsum, white, as above, minor interstitial brown-grey limestone.					
23.50-23.80	Collapse breccia, reddish brown, as above.					
23.80-24.90	Gypsum, white, 80% satin spar, 20% fine grained.					
24.90-25.63	Anhydrite, light grey, massive, dense.					
25.63-26.00	Gypsum, medium grey, as above, minor interstitial dark grey limestone.	R-1456	25.96-26.37	82.90	2.75	0.006
26.00-26.52	Gypsum, medium grey, common interstitial dark grey limestone.					
26.52-27.43	Gypsum, white, as above.					
27.43-27.92	Siltstone, breccia, reddish brown.					
27.92-29.02	Gypsum, anhydritic, white to medium grey, massive dense.	R-1457	28.12-28.45	86.48	13.56	0.003
29.02-30.33	Siltstone, breccia, as above.					
30.33-32.80	Gypsum, white, massive, fine grained, minor interstitial black limestone.	R-1458 R-1459	30.78-31.07 32.46-32.79	96.99 96.56	2.46 2.61	0.007 0.005
32.80-32.92	Shale, breccia, grey green, thinly laminated 45° to core axis.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
32.92-33.10	Limestone, dark grey to black, massive, dense minor gypsum and celestite.					
33.10-34.32	Siltstone breccia, reddish brown to grey green, clasts in calcareous mudstone matrix.					
34.32-34.84	Gypsum, white, fine grained, dense.	R-1460	34.54-34.80	97.66	2.27	0.004
34.84-35.36	Anhydrite, light grey brecciated.					
35.36-35.75	Siltstone, medium grey green, brecciated.					
35.75-37.73	Gypsum, medium grey, massive, dense, minor reddish-brown interbeds.	R-1461	35.87-36.17	90.78	2.41	0.004
37.37-38.16	Gypsum, light grey, anhydritic, massive, dense, 20% anhydrite.					
38.16-38.31	Limestone, medium to dark grey, gypsiferous, massive, dense, fine grained, 40% gypsum.					
38.31-38.44	Siltstone, reddish brown, brecciated, as above.					
38.44-38.65	Sandstone, medium to dark grey, calcareous.					
38.65-39.01	Gypsum, white, common interstitial reddish-brown siltstone.					
39.01-40.26	Breccia, reddish brown to grey green, siltstone, limestone and celestite in mudstone matrix.					
40.26-43.37	Siltstone, reddish brown, massive, soft with increasing blebs of white gypsum towards base up to 60% gypsum.					
43.37-46.91	Gypsum, light to medium grey, anhydrite up to 20%, minor selenite.					
46.91-53.37	Anhydrite, light grey, variably gypsiferous decreasing towards base of unit.	R-1462	43.97-44.27	96.09	2.41	0.006
		R-1463	48.39-48.72	61.25	36.40	0.010
		R-1464	49.68-50.04	20.26	70.19	0.007
		R-1465	51.31-51.61	30.58	62.55	0.007
		R-1466	52.93-53.24	9.13	87.15	0.004

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
53.37-53.74	Siltstone, reddish brown, massive, dense, 30% included anhydrite.					
53.74-60.35	Anhydrite, light to medium grey, massive, dense, common selenite rosettes, minor interstitial red silt.	R-1467	56.16-56.49	9.37	75.70	0.007
60.35-60.81	Siltstone, reddish brown, as above.					
60.81-62.64	Anhydrite, light to medium grey, minor interstitial siltstone.					
62.64-63.52	Gypsum, white, fine grained, dense.					
63.52-64.31	Siltstone, medium grey green, calcareous, thinly laminated minor gypsum filled fractures.					
64.31-69.49	Limestone, medium grey brown, thinly laminated, fine grained.					
69.49-71.99	Limestone, medium to dark grey, massive, very fine grained.					
71.99-86.70	Limestone, medium to dark grey, massive, very fine grained, fossiliferous, brachiopod shells.					
86.70-89.46	Conglomerate, much core missing.					
89.46-89.67	Limestone, dark grey to black, massive, dense fine grained.					
89.67-91.07	Sandstone, medium grey green, coarse grained, massive, dense, minor sulphides.					
91.07-93.88	Basement, ? medium grained granodiorite.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: S. Forgeron

Property: Dundee, Occurrence 0014  
Hole Number: KC-BR-3  
Latitude: 45°41'59"  
Longitude: 61°07'25"  
Elevation:

Azimuth:  
Dip:  
Started:  
Completed:  
Ultimate Depth: 74.98 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-10.67	Overburden.					
10.67-12.19	Muddy gypsum, medium grey to white, massive, about 40% mudstone.					
12.19-13.59	Cavity.					
13.59-15.54	Limy gypsum, white to dark grey, fine grained, dense gypsum with 30% limestone fragments scattered throughout.					
15.54-16.40	Limestone, black, dense, very fine grained, appears algal cut by calcite filled fractures.					
16.40-17.04	Mudstone, medium grey, massive, dense, bottom 30 cm cut by fractures filled by satin spar.					
17.04-19.26	Gypsum, white to light grey, top half contains up to 20% mudstone fragments, bottom massive with minor selenite crystals.					
19.26-22.62	Gypsiferous anhydrite, medium to dark grey, massive dense.					
22.62-23.35	Mudstone, black, calcareous, massive, dense, cut by satin spar filled fractures.					
23.35-24.60	Gypsum, dirty, medium to dark grey, massive, dense, 50% mudstone, 50% gypsum.					
24.60-29.02	Limestone/muddy gypsum, medium to dark grey, massive, dense interbedded 50% gypsum, 40% limestone, 10% mudstone.					
29.02-29.29	Mudstone, black, massive, dense, cut by satin spar filled fractures.					
29.29-31.24	Dolomitic, dark brown to black, massive, grades to limestone in mid unit back to dolostone at base. Sandstone, medium grey green, massive, dense, medium-to coarse-grained.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
33.10-35.54	Mudstone, dark grey, massive, dense, cut by gypsum filled fractures.					
35.54-56.60	Anhydrite, light grey to reddish brown, massive, dense minor gypsum at top and base, selenite crystals throughout.	R-1491	37.97-38.25	87.82	0.45	0.025
		R-1492	41.05-41.40	25.04	68.03	0.038
		R-1493	42.27-42.57	26.09	66.09	0.026
		R-1494	44.04-44.35	39.04	57.54	0.012
		R-1495	45.70-46.00	42.86	49.69	0.016
		R-1496	47.04-47.32	25.85	59.31	0.012
		R-1497	48.64-48.94	36.70	53.36	0.014
		R-1498	50.32-50.88	21.84	74.88	0.008
		R-1499	53.70-54.03	38.56	48.99	0.012
		R-1500	55.22-55.57	98.14	1.41	0.007
		R-1501	56.44-56.74	71.14	0.93	0.009
56.60-58.00	Limestone, medium to dark grey, massive, dense.					
58.00-58.49	Gypsum, white to brown, massive, dense, fine grained common selenite crystals.					
58.49-69.37	Limestone, medium grey to black, massive, dense, vague bedding 5° to core axis near top.					
68.37-70.50	Sandstone, light to medium grey, medium grained, moderate to highly calcareous, bedding 5-10° to core axis.					
70.50-71.11	Conglomerate, medium grey green, large basement clasts in a calcareous sandy matrix.					
71.11-72.60	Andesite, dark grey green, aphanitic, very dense, cut by a few quartz filled fractures.					
72.60-74.98	Granodiorite, pinkish green, aphanitic very dense a few quartz and calcite filled fractures.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: S. Forgeron



Property: Dundee, Occurrence 0014  
 Hole Number: KC-BR-5  
 Latitude: 45°41'59"  
 Longitude: 61°07'20"  
 Elevation:

Azimuth:  
 Dip:  
 Started:  
 Completed:  
 Ultimate Depth: 26.82 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-5.49	Overburden.					
5.49-7.19	Lost core.					
7.19-7.62	Breccia, pebbles of light grey, coarse sandstone and reddish-brown siltstone in a sandy, calcareous siltstone matrix.					
7.62-9.97	Lost core.					
9.97-11.98	Gypsum, white, fine grained.					
11.98-12.31	Collapse breccia, fragments of reddish-brown siltstone, green-grey sandstone and black limestone in a silty matrix cut by stringers of satin spar.					
12.31-12.44	Gypsum, white, fine grained.					
12.44-13.14	Collapse breccia, as above.					
13.14-15.94	Gypsum, light grey, massive, dense, anhydritic.	R-1484	12.93-13.23	97.95	0.80	0.002
15.94-19.69	Gypsum, light grey to white, massive, dense, very fine grained.	R-1485	16.61-16.94	86.34	3.82	0.007
		R-1486	17.78-18.11	93.79	3.63	0.010
		R-1487	19.00-19.33	93.89	3.37	0.011
19.69-24.14	Anhydrite, light to medium grey, massive, dense, frequent selenite rosettes, minor to common gypsum.	R-1488	21.16-21.51	23.65	65.59	0.017
		R-1489	22.53-22.78	16.53	77.97	0.011
		R-1490	23.80-24.13	47.35	49.01	0.008
24.14-24.78	Gypsum, white, fine grained.					
24.78-26.82	Gypsum, anhydritic, slightly silty.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: S. Forgeron

Property: Dundee, Occurrence 0014  
 Hole Number: KC-BR-11  
 Latitude: 45°41'38"  
 Longitude: 61°05'26"  
 Elevation:

Azimuth:  
 Dip:  
 Started:  
 Completed:  
 Ultimate Depth: 65.84 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-26.64	Overburden.					
26.64-29.32	Collapse breccia, grey-green to reddish-brown mud matrix with green-grey siltstone and dark grey limestone clasts.					
29.32-32.61	Lost core.					
32.61-33.16	Limestone, dark grey to black, massive, fine grained.					
33.16-35.97	Lost core.					
35.97-35.98	Limestone, dark grey to black, massive, contains algal buns.					
36.98-41.64	Lost core.					
41.64-45.72	Limestone, dark grey to black, fractured, healed by calcite, fossiliferous, small rugose coral.					
45.72-48.16	Lost core.					
48.16-54.56	Siltstone, reddish brown mottled green grey, only 1.74 m recovered.					
54.56-55.05	Lost core.					
55.05-55.66	Gypsum, white, fine grained.					
55.66-58.89	Anhydrite, light grey, common gypsum along fractures.	R-1479	58.52-58.83	16.39	83.95	0.008
58.89-59.56	Gypsum, light grey, fine grained.					
59.56-59.98	Siltstone breccia, reddish brown, slightly calcareous.					
59.98-60.35	Gypsum, light grey.	R-1480	60.05-60.35	97.95	1.70	0.004
60.35-65.84	Anhydrite, light grey, minor gypsum along fractures.	R-1481 R-1482	62.97-63.25 65.51-65.84	9.51 10.13	88.56 87.72	0.010 0.019
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: G. Adams

Property: Dundee, Occurrence 0014  
Hole Number: KC-BR-15  
Latitude: 45°41'49"  
Longitude: 61°05'03"  
Elevation:

Azimuth:  
Dip:  
Started:  
Completed:  
Ultimate Depth: 60.05 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-5.18	Overburden, 0.73 m of core recovered consisting of granitic material, siltstone and limy sandstone.					
5.18-14.33	Limestone pebbles, 1.65 m of core recovered as angular pebbles of medium brown, dark grey and light grey limestone.					
14.33-17.37	Mud, reddish brown, 1.07 m of core recovered, very soft.					
17.37-20.42	Siltstone, reddish brown, 1.31 m of core recovered, massive, soft, slightly calcareous, traces of gypsum.					
20.42-23.47	Gypsum, light grey white, 0.37 m of core recovered, fine grained, dense.					
23.47-23.90	Cavity, minor gypsum and siltstone/mud clasts infilling.					
23.90-26.06	Siltstone, reddish brown, soft, massive, minor satin spar.					
26.06-40.69	Gypsum, white, massive, fine-to medium-grained, minor interstitial grey-brown limestone, grades to anhydrite at base of unit.	R-1470	26.69-27.05	97.52	2.43	0.001
		R-1471	29.57-29.89	91.31	2.19	0.011
		R-1472	32.61-32.97	94.75	1.61	0.004
		R-1502	34.14-34.44	95.99	0.31	0.005
		R-1503	37.34-37.72	98.43	0.91	0.005
		R-1504	39.09-39.40	98.95	0.77	0.004
40.69-49.13	Anhydrite, medium to light grey, massive, dense, minor interstitial dark grey limestone.	R-1505	40.56-40.89	55.86	42.55	0.013
		R-1506	41.99-42.29	7.55	89.81	0.009
		R-1507	45.13-45.46	6.50	93.79	0.009
49.13-49.72	Limestone, medium grey brown, massive brecciated fractures filled by anhydrite.	R-1508	48.31-48.62	23.56	62.04	0.023
49.72-50.05	Mudstone, light grey, massive, soft, cut by gypsum filled fractures.					
50.05-53.52	Anhydrite, medium grey, massive, dense, minor to common interstitial grey-brown limestone at base.	R-1509	51.26-51.54	10.70	81.94	0.005
		R-1510	52.68-52.96	7.07	88.18	0.004
		R-1511	54.00-54.30	16.48	58.23	0.010
53.52-54.07	Limestone, medium grey brown, as above.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
54.07-55.44	Anhydrite, light to medium grey, as above.					
55.44-56.14	Mudstone, reddish brown mottled green grey, massive, dense, cut by numerous satin spar filled fractures.					
56.14-56.81	Anhydrite, medium grey, massive, dense.					
56.81-57.58	Mudstone, light grey, massive, dense, soft.					
57.58-60.05	Anhydrite, medium grey, as above.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: S. Forgeron

**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

**Property:** Loch Lomond, Occurrence 0027  
**Hole Number:** KC-112  
**Latitude:** Not Available  
**Longitude:** Not Available  
**Elevation:**

**Azimuth:**  
**Dip:**  
**Started:**  
**Completed:**  
**Ultimate Depth:** 249.33 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-14.94	Overburden.					
14.94-23.77	Sandstone.					
23.77-26.82	Shale and siltstone.					
26.82-32.92	Sandstone and gypsum.					
32.92-35.97	Dolomitic sandstone, shale and gypsum.					
35.97-41.45	Dolomitic sandstone.					
41.45-42.52	Argillaceous sandstone.					
42.52-63.70	Sandstone.					
63.70-69.04	Limestone.					
69.04-70.77	Claystone.					
70.77-81.23	Sandstone.					
81.23-82.60	Limestone.					
82.60-84.12	Sandstone.					
84.12-87.93	Limestone.					
87.93-88.09	Shale.					
88.09-88.73	Limestone.					
88.73-96.50	Sandstone and conglomerate sandstone.					
96.50-100.71	Limestone.					
100.71-101.50	Sandstone and conglomerate.					
101.50-103.51	Limestone conglomerate.					
103.51-104.00	Sandstone.					
104.00-104.30	Conglomerate.					
104.30-112.93	Limestone.					
112.93-116.59	Conglomerate.					
116.59-121.98	Sandstone.					



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
121.98-133.32	Conglomerate or breccia minor SrSO ₄					
133.32-135.54	Limestone, fine grains of SrSO ₄					
135.54-137.16	Breccia, few fragments of SrSO ₄					
137.16-138.29	SrSO ₄					
138.29-145.39	Breccia, scattered SrSO ₄					
145.39-146.43	Limestone, heavy core of fine grained SrSO ₄					
146.43-149.94	Interbedded red and grey-green siltstone and orange satin spar.					
149.94-151.49	Gypsum, grey white, nodular, common interstitial grey-green siltstone and grey-brown limestone.	R-1627	151.05-151.41	94.89	2.56	0.008
151.49-165.20	Anhydrite, light grey, massive, minor interstitial grey gypsum along fractures near top, minor interstitial grey-brown limestone, in part grades to dolomitic limestone at base.	R-1628	152.25-152.55	1.91	97.91	0.010
		R-1629	153.82-154.15	3.35	96.13	0.010
		R-1630	154.97-155.27	3.54	95.55	0.012
		R-1631	157.05-157.38	3.54	94.62	0.011
		R-1632	158.93-159.26	2.77	92.49	0.009
		R-1633	160.40-160.71	3.92	91.14	0.009
		R-1634	162.10-162.38	2.49	87.92	0.008
		R-1635	163.55-163.85	2.87	88.46	0.011
		R-1636	164.95-165.28	2.25	84.01	0.008
165.20-173.49	Dolostone, grey brown, common to abundant included light grey anhydrite.					
173.49-175.99	Limestone, grey brown.					
175.99-177.14	Dolostone, grey brown, as above.					
177.14-198.97	Anhydrite, grey white, nodular to nodular mosaic, top 4.6 m have been sampled previously.	R-1637	181.91-198.22	2.53	97.03	0.005
		R-1638	183.18-183.51	2.96	96.89	0.008
		R-1639	185.45-185.75	3.49	96.88	0.008
		R-1640	186.79-187.10	2.10	92.86	0.008
		R-1641	188.54-188.80	2.63	95.66	0.006
		R-1642	189.97-190.27	3.97	94.16	0.008
		R-1645	191.11-191.41	2.96	94.54	0.006
		R-1646	192.61-192.91	2.87	97.46	0.006
		R-1647	194.08-194.41	3.06	97.07	0.009
		R-1648	195.58-195.86	2.63	97.65	0.011
		R-1649	196.90-197.25	6.45	91.21	0.007
198.97-200.99	Dolomitic sandstone.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
200.99-204.34	Limestone.					
204.34-206.53	Anhydrite.					
206.53-207.29	Sandstone.					
207.29-214.88	Anhydrite, light blue, massive, grades in gypsum towards base to nodular, minor to common interstitial grey-brown dolostone.	R-1650	208.48-208.79	4.11	95.73	0.008
		R-1651	210.24-210.57	4.40	95.50	0.006
		R-1652	212.14-212.40	20.26	76.01	0.005
		R-1643	212.83-213.16	9.32	83.05	0.006
		R-1644	214.40-214.68	10.99	72.92	0.008
214.88-215.52	Limestone.					
215.52-225.25	Sandstone.					
225.25-232.26	Limestone.					
232.26-233.14	Sandstone.					
233.14-233.45	Shale.					
233.45-245.52	Conglomerate.					
245.52-249.33	Basement rocks.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: G. Adams

**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

<b>Property:</b>	Rear Balls Creek, Occurrence 0029	<b>Azimuth:</b>
<b>Hole Number:</b>	FV-1	<b>Dip:</b>
<b>Latitude:</b>	46°08'08"	<b>Started:</b>
<b>Longitude:</b>	60°20'10"	<b>Completed:</b>
<b>Elevation:</b>		<b>Ultimate Depth:</b> 78.33 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-2.13	Overburden.					
2.13-17.56	Interbedded reddish-brown siltstone and grey-green sandstone dips 15-25° to core axis, moderately calcareous, some core missing at base of unit.					
17.56-20.79	Mudstone/gypsum, 40% fine grained, white gypsum and satin spar in grey-green mudstone matrix.					
20.79-72.86	Gypsum, white, massive, dense, minor interstitial siltstone and selenite rosettes throughout.					
22.86-23.50	Mudstone/gypsum, 30% gypsum, as above.					
23.50-60.23	Interbedded reddish-brown siltstone and sandstone dips 23-29° to core axis, slightly calcareous.					
60.23-62.76	Limestone, medium- to light-brown, massive, fine grained fractured.					
62.76-65.32	Gypsum, white, massive, dense, fine grained, minor selenite rosettes, minor to common interstitial grey dolostone.	R-1446	62.76-63.09	84.86	0.97	0.005
		R-1447	64.31-64.67	89.68	0.64	0.007
65.32-73.15	Anhydrite, light grey, massive, dense, slightly gypsiferous minor interstitial grey dolostone more abundant towards base of unit.	R-1448	65.89-66.14	20.50	69.49	0.007
		R-1449	67.39-67.69	10.23	80.67	0.008
		R-1450	68.53-68.78	28.72	62.38	0.011
		R-1451	70.36-70.66	27.90	58.23	0.007
		R-1452	71.38-71.68	26.90	52.18	0.008
73.15-78.33	Shale, dark grey, thinly laminated 20° to core axis, highly calcareous, approximately 30% gypsum and anhydrite.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: S. Forgeron

**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

<b>Property:</b>	Lizzies Lake, Occurrence 0030	<b>Azimuth:</b>	
<b>Hole Number:</b>	KC-434	<b>Dip:</b>	90°
<b>Latitude:</b>	45°41'36"	<b>Started:</b>	
<b>Longitude:</b>	60°38'18"	<b>Completed:</b>	
<b>Elevation:</b>		<b>Ultimate Depth:</b>	66.14 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-7.62	Overburden.					
7.62-24.66	Breccia, probable sink hole, light brown to red mud with Horton clastic fragments.					
24.66-30.08	Gypsum, white to light grey, massive gypsum with minor to abundant interstitial grey calcareous mudstone/siltstone.	R-1453	25.73-26.04	99.72	0.40	0.005
		R-1454	28.73-29.06	94.80	3.23	0.004
30.08-31.76	Mudstone, dark brown, soft, minor clastic fragments.					
31.76-34.29	Mudstone/limestone, medium grey brown, alternating 50 mm layers of soft mudstone and limestone.					
34.29-36.30	Limestone, medium to dark grey, massive, slightly broken and shaly, crinoidal.					
36.30-38.71	Limestone, medium grey, massive, dense, fossiliferous (brachiopods).					
38.71-40.93	Limestone, light grey to buff, massive, dense, fossiliferous quite porous.					
40.93-43.68	Limestone, light grey to buff, massive, dense, less porous slightly algal.					
43.68-63.70	Siltstone, reddish brown, massive, slightly broken, sandy towards base of unit.					
63.70-66.14	Sandstone, reddish brown medium- to coarse-grained.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: C. MacPherson

**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

<b>Property:</b>	Malagawatch, Occurrence 0035	<b>Azimuth:</b>	
<b>Hole Number:</b>	CBD-7-78	<b>Dip:</b>	
<b>Latitude:</b>	45°52'10"	<b>Started:</b>	
<b>Longitude:</b>	60°59'40"	<b>Completed:</b>	
<b>Elevation:</b>		<b>Ultimate Depth:</b>	227.69 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-6.71	Overburden.					
6.71-28.60	Gypsum, white to light grey, minor to common interstitial dark grey dolostone, minor cavities infilled by dolostone.	R-1309	6.86-7.19	98.91	1.42	0.015
		R-1310	8.36-8.61	88.54	1.51	0.010
		R-1311	10.72-11.07	93.03	0.94	0.015
		R-1312	11.63-11.91	82.71	2.27	0.012
		R-1313	12.90-13.18	85.05	1.79	0.016
		R-1314	14.71-15.06	93.03	1.29	0.015
		R-1315	18.08-18.36	98.91	1.23	0.020
		R-1316	20.60-20.93	98.81	0.22	0.016
		R-1317	23.80-24.10	99.67	0.25	0.011
		R-1318	27.03-27.30	98.19	1.09	0.013
28.60-30.07	Anhydrite, light grey, weathered, fractured common white gypsum along fractures.					
30.07-32.28	Gypsum, white to light grey, minor to common interstitial black mudstone and grey dolostone, minor laminae 80-90° to core axis.	R-1319	30.23-30.58	94.27	0.51	0.028
32.28-35.56	Gypsum, light grey, minor interstitial and interlaminae of light grey mudstone/siltstone.	R-1320	33.28-33.63	98.76	0.19	0.021
35.56-35.66	Cavity, infilled by brown mudstone, igneous clasts included, minor gypsum filled fractures.					
35.66-36.68	Gypsum, white, minor interstitial dark grey mudstone siltstone, minor laminae 35° to core axis.	R-1321	36.22-36.55	95.32	0.67	0.010
36.68-36.75	Cavity, infilled by brown mudstone.					
36.75-37.19	Gypsum, white, minor interstitial dark grey mudstone.					
37.19-37.24	Cavity, as above.					
37.24-37.62	Gypsum, as above.					



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
37.62-37.67	Cavity, as above.					
37.67-38.15	Gypsum, grey white, vaguely laminated with minor black mudstone.	R-1322	37.77-38.08	99.72	0.59	0.008
38.15-38.28	Cavity, as above.					
38.28-38.38	Gypsum, as above.					
38.38-38.43	Cavity, as above.					
38.43-38.71	Gypsum, as above.					
38.71-38.89	Cavity, infilled by light grey siltstone.					
38.89-41.76	Gypsum, light grey, minor interstitial dark grey-brown dolostone more abundant towards base.	R-1323	39.60-39.88	99.24	0.46	0.006
		R-1324	40.79-41.15	84.24	1.02	0.012
41.76-42.54	Cavity, infilled by grey-brown siltstone, minor gypsum fragments included.					
42.54-43.08	Gypsum, grey white, minor interstitial dark grey mudstone/siltstone, vague laminae 40° to core axis.	R-1325	42.67-42.95	97.38	0.54	0.014
43.08-43.61	Cavity, infilled with light grey mudstone, minor anhydrite clasts.					
43.61-47.85	Gypsum, white, minor interstitial dark grey mudstone/siltstone.	R-1326	44.17-44.45	97.62	0.86	0.006
		R-1327	45.21-45.52	96.37	0.38	0.009
		R-1328	46.66-46.94	88.97	0.31	0.011
47.85-48.41	Cavity, infilled by calcareous brown mudstone with gypsum and siltstone clasts.					
48.41-51.56	Dolostone, dark grey, minor gypsum blebs.					
51.56-67.36	Mudstone, medium grey, slightly calcareous, minor to common gypsum blebs more common towards base. Contact gradational.					
67.36-68.43	Gypsum, light grey, minor to common interstitial grey mudstone most abundant at top of unit.	R-1329	67.97-68.32	93.41	0.94	0.036

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
68.43-71.02	Anhydrite, blue grey, minor interstitial gypsum along fracture.	R-1330	69.34-69.62	15.34	84.16	0.043
		R-1331	70.36-70.69	10.66	84.56	0.039
71.02-117.93	Anhydrite, blue grey to medium grey, massive.	R-1332	73.28-73.61	3.63	93.08	0.019
		R-1333	76.22-76.61	3.78	94.74	0.015
		R-1334	79.17-79.45	4.54	91.26	0.012
		R-1335	82.17-82.50	3.44	94.25	0.012
		R-1336	85.09-85.39	3.20	94.05	0.014
		R-1337	88.11-88.44	3.35	91.25	0.013
		R-1338	91.06-91.34	4.06	89.92	0.014
		R-1339	94.08-94.41	4.73	92.11	0.019
		R-1340	96.95-97.31	4.25	91.55	0.016
		R-1341	99.95-100.30	1.48	83.53	0.016
		R-1342	102.85-103.15	1.10	91.60	0.018
		R-1343	106.05-106.35	2.25	90.71	0.045
		R-1344	108.91-109.25	1.10	94.47	0.011
		R-1345	111.86-112.12	1.34	95.37	0.017
		R-1346	114.91-115.24	1.34	96.43	0.013
117.93-129.24	Anhydrite, grey, minor to abundant interstitial and interlaminated grey-brown limestone.	R-1347	117.96-118.24	2.72	71.62	0.023
		R-1348	121.01-121.33	1.29	94.35	0.013
		R-1349	123.75-124.05	3.39	75.07	0.027
		R-1350	126.39-126.70	1.43	58.45	0.055
129.24-140.51	Anhydrite, light blue, minor interstitial grey limestone.	R-1351	129.36-129.69	0.81	87.86	0.014
		R-1352	132.38-132.72	1.20	94.38	0.020
		R-1353	135.03-135.31	2.53	94.85	0.016
		R-1354	138.10-138.43	2.68	90.74	0.022
140.51-154.46	Anhydrite, light grey, minor to common interstitial and interlaminated grey-brown limestone.	R-1355	141.25-141.56	3.87	63.78	0.040
		R-1356	144.17-144.48	2.01	65.29	0.034
		R-1357	147.33-147.57	2.34	89.19	0.019
		R-1358	150.21-150.52	2.20	76.11	0.039
		R-1359	153.29-153.62	2.01	78.40	0.030
154.46-194.16	Anhydrite, light grey to blue grey, minor interstitial grey-brown limestone.	R-1360	156.11-156.41	2.87	86.42	0.030
		R-1361	159.11-159.43	3.92	83.47	0.022
		R-1362	162.05-162.38	2.49	93.02	0.019
		R-1363	165.10-165.43	3.58	92.59	0.022
		R-1364	168.10-169.40	2.63	97.12	0.013
		R-1365	171.07-171.43	1.82	95.23	0.017
		R-1366	174.07-174.39	1.77	96.36	0.017
		R-1367	177.06-177.42	3.68	82.04	0.021
		R-1368	180.01-180.29	3.25	80.94	0.022
		R-1369	182.96-183.26	3.11	83.92	0.021
		R-1370	185.95-186.31	3.25	93.94	0.023
		R-1371	189.33-189.63	2.82	96.58	0.017
		R-1372	192.12-192.43	4.01	94.31	0.030
194.16-195.33	Limestone, grey brown, minor to common anhydrite inclusions.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
195.33-195.99	Anhydrite, light grey, common interstitial grey-brown limestone decreases towards base of unit.	R-1373	195.40-195.68	3.25	70.15	0.032
195.99-211.48	Anhydrite, light grey, minor to common interstitial grey-brown limestone increases towards base.	R-1374	197.87-198.22	2.25	93.46	0.022
		R-1375	200.99-201.30	1.86	94.75	0.025
		R-1376	203.81-204.14	1.48	95.41	0.027
		R-1377	206.78-207.06	1.48	94.92	0.020
		R-1378	209.70-210.01	5.59	93.77	0.018
211.48-212.09	Limestone, grey brown, laminae 55° to core axis, increasing included anhydrite towards base of unit.					
212.09-222.05	Anhydrite, grey, minor interstitial grey-brown limestone.	R-1379	212.62-212.90	1.77	93.62	0.019
		R-1380	215.49-215.80	2.25	94.52	0.016
		R-1381	218.54-218.85	3.25	94.22	0.015
		R-1382	221.59-221.92	6.83	89.54	0.026
222.05-223.37	Anhydrite, grey, minor to common interstitial grey-brown limestone and gypsum along fractures.	R-1383	222.71-223.04	55.19	23.45	0.047
223.37-226.57	Limestone, grey brown, minor laminae 50° to core axis.					
226.57-227.69	Granite, weathered.					
	End of Hole.					

Drilling Performed By: Nova Scotia Department of Mines and Energy

Geologist: R. Sproule

Property: Malagawatch, Occurrence 0035  
Hole Number: CBD-9-78  
Latitude: 45°51'50"  
Longitude: 60°59'30"  
Elevation:

Azimuth:  
Dip:  
Started:  
Completed:  
Ultimate Depth:

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-6.10	Overburden.					
6.10-8.66	Gypsum, white to grey white, minor to common interstitial dark grey dolostone.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
8.66-10.06	Cavity, infilled by red mudstone clasts in grey-green mudstone matrix.					
10.06-10.19	Gypsum, white, minor grey siltstone interlaminae 55° to core axis.					
10.19-10.44	Cavity, as above.					
10.44-11.30	Gypsum, white, saccharoidal, minor to common interlaminae of grey siltstone.	R-1385	10.80-11.13	94.41	0.84	0.005
11.30-11.73	Cavity, infilled by red calcareous mudstone mottled grey green, minor gypsum inclusions.					
11.73-15.72	Gypsum, grey white, saccharoidal, minor interlaminae of black mudstone 45° to core axis.	R-1386 R-1387	11.89-12.22 14.55-14.89	98.62 92.31	0.45 1.06	0.007 0.008
15.72-16.08	Cavity, infilled by red calcareous mudstone mottled grey green, minor gypsum inclusions.					
16.08-16.43	Gypsum, grey white, vaguely laminated, minor dark grey interstitial mudstone.					
16.43-16.64	Cavity, as above.					
16.64-17.50	Gypsum, white grey, saccharoidal, 50% interstitial grey dolostone (some core missing).					
17.50-22.35	Cavity, as above.					
22.35-23.77	Mudstone, grey green, gypsiferous, gypsum increases towards base.	R-1388	23.47-23.75	95.89	0.35	0.010
23.77-25.78	Gypsum, white, minor interstitial grey mudstone/dolostone.	R-1389	25.09-25.40	99.48	0.66	0.011
25.78-26.29	Anhydrite, blue grey, common white gypsum along fractures.					
26.29-27.38	Anhydrite, blue grey, massive.					
27.38-28.35	Anhydrite, blue grey, common white gypsum along fractures.	R-1390	27.74-28.04	12.71	83.45	0.260

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
28.35-75.72	Anhydrite, blue grey, massive, minor gypsum filled fractures, 25 mm grey silt filled cavity at 66.14 m, minor interstitial grey limestone.	R-1391	31.01-31.37	2.06	92.32	0.020
		R-1392	33.93-34.27	2.29	95.45	0.014
		R-1393	36.45-36.73	3.73	94.72	0.016
		R-1394	39.88-40.18	2.58	94.97	0.016
		R-1395	42.85-43.13	3.87	92.81	0.020
		R-1396	45.82-46.15	2.49	94.78	0.017
		R-1397	48.77-49.05	2.39	95.29	0.016
		R-1398	51.66-51.97	2.49	94.68	0.015
		R-1399	54.71-54.99	2.92	93.85	0.015
		R-1400	57.63-57.94	5.02	91.29	0.015
		R-1401	60.58-60.88	3.63	93.62	0.015
		R-1402	63.53-63.86	3.68	90.44	0.017
		R-1403	66.52-66.88	2.58	93.47	0.015
		R-1404	68.58-68.93	2.49	94.68	0.015
		R-1405	71.27-71.60	3.15	96.23	0.010
		R-1406	74.27-74.58	2.68	89.43	0.015
75.72-76.73	Anhydrite, grey, interlaminae of grey-brown limestone laminae 70° to core axis.					
76.73-85.50	Anhydrite, grey blue, massive, minor interstitial grey limestone, 25 mm cavity at 85.14 m infilled by green sandstone.	R-1407	77.27-77.57	2.06	91.68	0.020
		R-1408	80.26-80.60	1.58	94.20	0.013
		R-1409	83.19-83.52	2.20	89.49	0.015
85.58-88.01	Anhydrite, grey, common grey limestone interlaminae 70° to core axis, limestone increases towards middle of unit decreases towards top and base.	R-1410	86.18-86.46	1.58	69.21	0.022
88.01-101.88	Anhydrite, grey blue, massive, minor gypsum filled fracture at 97.16 m, minor interstitial grey-brown limestone.	R-1411	89.21-89.54	2.29	92.86	0.014
		R-1412	92.10-92.43	1.86	94.68	0.015
		R-1413	95.15-95.45	3.35	94.06	0.013
		R-1414	98.40-98.65	3.35	91.05	0.022
		R-1415	101.22-101.50	2.72	89.22	0.015
101.88-116.36	Anhydrite, grey blue, common interlaminae of grey-brown limestone 70-60° to core axis.	R-1416	104.13-104.49	2.96	61.61	0.032
		R-1417	105.77-106.07	2.58	78.47	0.032
		R-1418	108.81-109.12	1.72	88.44	0.017
		R-1419	112.04-112.34	3.44	71.77	0.026
		R-1420	114.91-115.26	3.25	76.53	0.024
116.36-155.75	Anhydrite, light blue, minor interstitial grey-brown limestone.	R-1421	117.96-118.26	3.54	90.35	0.017
		R-1422	121.03-121.31	2.63	92.62	0.014
		R-1423	124.05-124.36	9.89	85.88	0.009
		R-1424	127.10-127.43	2.15	96.41	0.019
		R-1425	128.63-128.93	2.29	96.72	0.016
		R-1426	131.01-131.34	2.87	95.52	0.033
		R-1427	134.36-134.70	3.11	95.43	0.018
		R-1428	137.54-137.85	1.10	93.93	0.028
		R-1429	140.51-140.84	0.91	91.22	0.019



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
		R-1430	143.71-144.07	1.39	93.50	0.031
		R-1431	146.66-146.99	0.96	90.03	0.027
		R-1432	149.69-149.99	0.96	94.38	0.020
		R-1433	152.73-153.03	1.48	94.37	0.021
		R-1434	155.02-155.35	2.92	80.64	0.028
155.75-156.41	Limestone, grey brown, laminated 70° to core axis, common blebs of anhydrite at top and base.					
156.41-168.81	Anhydrite, grey blue, common interstitial grey-brown limestone at top, common to abundant white gypsum along fractures at base.	R-1435	157.28-157.58	3.39	90.79	0.025
		R-1436	159.18-159.51	6.12	92.05	0.015
		R-1437	162.15-162.43	2.15	94.44	0.012
		R-1438	165.13-165.46	3.06	94.59	0.020
		R-1439	168.20-168.45	57.48	41.06	0.055
168.81-180.70	Gypsum, white, nodular in part, minor to common interstitial dark grey to grey-green limestone.	R-1440	169.77-170.08	96.71	0.97	0.030
		R-1441	171.40-171.68	95.18	0.17	0.022
		R-1442	173.23-173.48	98.43	0.08	0.031
		R-1443	176.05-176.38	98.76	0.09	0.019
		R-1444	177.85-178.16	93.51	0.08	0.047
		R-1445	180.42-180.70	93.94	0.66	0.039
180.70-184.10	Limestone, medium grey, laminated 40° to core axis, vuggy at top, minor fossils.					
184.10-186.23	Granite, weathered.					
	End of Hole.					

Drilling Performed By: Longyear

Geologist: G. R. Sproule

**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

<b>Property:</b>	Chéticamp, Occurrence 0047	<b>Azimuth:</b>	
<b>Hole Number:</b>	CH-1	<b>Dip:</b>	
<b>Latitude:</b>	46°36'23'	<b>Started:</b>	
<b>Longitude:</b>	60°58'55'	<b>Completed:</b>	
<b>Elevation:</b>		<b>Ultimate Depth:</b>	403.56 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0.0-2.74	Casing through overburden.					
2.74-57.61	Interbedded shales and sandstone, primarily dark grey and green in colour, occasionally reddish.					
57.61-58.00	Clay, reddish and green.					
58.00-58.09	Siltstone.					
58.09-65.53	Shale, grey green, strongly brecciated.					
65.53-66.14	Gypsum, grey, mosaic with abundant interstitial grey mudstone less common towards bottom.	R-1059	65.53-65.63	99.53	1.23	0.011
66.14-66.45	Gypsum, black, selenitic.	R-1060	66.24-66.50	97.38	2.71	0.007
66.45-68.10	Gypsum, white, massive to mosaic; 66.30-66.80 cavity infilled with calcareous grey siltstone. Minor siltstone interlaminae 30° to core axis, silty at base.	R-1061	67.59-67.95	91.16	1.73	0.049
68.10-70.41	Siltstone, shaly, grey to dark grey, highly calcareous a few gypsum filled fractures 50° to core axis. Contact erosional.					
70.41-77.42	Gypsum, brownish grey with common interstitial dolostone and limestone, minor satin spar filled fractures, few interlaminae 65° to core axis.	R-1062	70.41-70.71	92.84	2.75	0.012
		R-1063	71.60-71.88	58.53	40.89	0.035
		R-1064	72.98-73.15	51.89	46.35	0.038
		R-1065	71.35-71.63	56.00	27.96	0.044
		R-1066	76.05-76.35	56.29	34.18	0.027
77.42-80.50	Limestone, highly brecciated, salty to taste.					
80.50-86.44	Shale, grey green, highly brecciated, matrix of red clay.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
86.44-90.65	Gypsum, white to light grey, massive to nodular, highly weathered core, minor interstitial dolostone laminae 50° to core axis.	R-1067	86.66-86.89	93.55	6.05	0.013
		R-1068	88.09-88.34	53.47	41.02	0.031
		R-1069	89.31-89.59	33.88	64.16	0.052
90.65-91.21	Limestone, light grey, fine grained, thin bedded 20° to core axis. Erosional contact.					
91.21-98.05	Gypsum, light grey, with abundant interstitial limestone. 67 mm thick grey shale interbed near top of unit.					
98.05-103.33	Limestone, grey, fine grained, massive, brecciated, minor gypsum filled fractions. Eroded contact.					
103.33-109.42	Gypsum, light grey, badly weathered core, abundant interstitial limestone at top, minor laminations 55-65° to core axis.	R-1071	105.00-105.30	59.49	18.11	0.023
		R-1072	106.48-106.86	56.81	35.40	0.076
		R-1073	107.67-107.95	63.60	18.45	0.054
		R-1074	108.87-109.12	68.90	26.44	0.008
109.42-119.48	Mudstone, light grey at top to red at base, massive, brecciated at base, gypsum filled fractures 0.20 to 2.5 cm thick 65° to core axis. Erosional contact.					
119.48-119.81	Gypsum, light grey, porous. Erosional contact.	R-1075	119.48-119.71	91.45	7.93	0.025
119.81-119.99	Limestone, grey, poorly consolidated.					
119.99-120.29	Gypsum, light grey, massive, porous with laminae 40° to core axis. Erosional contact.					
120.29-122.83	Mudstone, red above, grey below, poorly consolidated, minor gypsum filled fractures 90° to core axis.					
112.83-126.49	Gypsum, white, nodular with common interstitial dolostone, laminae 40° to core axis. Erosional contact.	R-1076	122.83-123.08	79.27	13.54	0.020
		R-1077	124.26-124.54	43.96	53.12	0.014
		R-1078	125.62-125.98	54.42	41.85	0.063
126.49-126.80	Limestone, olive green, minor gypsum filled fractures increasing towards base of unit, laminae 60° to core axis.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
126.80-129.97	Gypsum, white to light grey, abundant interstitial grey siltstone at top. Contact erosional.	R-1079	126.96-127.23	37.17	36.62	0.130
		R-1080	128.58-128.88	45.34	52.09	0.026
		R-1081	129.56-129.92	59.01	34.87	0.039
129.97-132.36	Limestone, grey, interlaminae of light grey gypsum at the top, grades to gypsum at base.					
132.36-135.84	Gypsum, light grey, cavity 134.72-134.85 m.	R-1082	132.89-133.20	59.77	31.39	0.043
		R-1083	135.64-135.97	76.07	19.84	0.025
135.84-137.36	Mudstone, grey, poorly consolidated, cut by satin spar filled fractures 80-90° to core axis. Contact erosional.					
137.36-138.35	Gypsum, grey, saccharoidal texture, minor gypsum filled fractures 80° to core axis.	R-1084	138.07-138.32	67.90	24.89	0.014
138.35-138.51	Gypsum, grey, abundant interstitial clay, slightly calcareous.					
138.51-139.45	Limestone, dark grey, calcareous, poorly consolidated.					
139.45-140.34	Gypsum, brownish grey, very impure with abundant interstitial grey calcareous mud.					
140.34-141.58	Cavity, infilled with brownish-grey, calcareous mud.					
141.58-144.04	Gypsum, light grey, common to abundant interstitial calcareous grey mud, minor gypsum filled fractures, vague laminations 85° to core axis, poorly consolidated at base.	R-1085	141.59-141.88	37.60	13.31	0.051
		R-1086	142.60-142.88	59.77	39.07	0.023
144.04-144.22	Cavity, infilled by brecciated red mudstone.					
144.22-146.38	Gypsum, brownish grey, saccharoidal texture, abundant interstitial grey mud, minor laminae 65° to core axis.	R-1087	144.34-144.60	56.33	42.07	0.041
		R-1088	145.65-145.94	65.84	27.96	0.026
146.38-147.12	Cavity, infilled by poorly consolidated grey silt/mud, minor gypsum filled fractures.					
147.12-148.21	Gypsum, white to light grey, common interstitial grey mud, minor laminae 65° to core axis.	R-1089	147.42-147.73	61.30	37.25	0.036

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
148.21-148.95	Cavity, infilled by grey mudstone with minor laminae 30° to core axis, mottled grey green towards base.					
148.95-160.40	Gypsum, grey variably white, minor to abundant interstitial limestone and or calcareous mudstone.	R-1090	149.05-149.40	46.68	53.82	0.029
		R-1091	150.74-151.05	55.00	43.67	0.042
		R-1092	152.40-152.68	14.72	81.13	0.022
		R-1093	153.41-153.70	27.86	68.42	0.022
		R-1094	154.84-155.12	21.93	72.76	0.022
		R-1095	156.32-156.57	45.06	47.35	0.005
		R-1096	157.66-157.94	27.57	51.84	0.011
		R-1097	158.78-159.11	64.03	1.33	0.007
		R-1098	159.68-159.97	58.72	2.56	0.009
160.40-161.29	Limestone, brownish grey.					
161.29-161.54	Gypsum, white to light grey, minor to common interstitial grey mudstone.					
161.54-163.07	Limestone, grey, highly brecciated.					
163.07-177.88	Shale, red mottled green, brecciated.					
177.88-180.69	Limestone, greenish grey, partially unconsolidated. Contact erosional.					
180.69-183.34	Gypsum, white to light grey, minor interstitial dark grey limestone decreasing towards base of unit. Minor laminae 40° to core axis. Contact is eroded.	R-1099	183.08-183.34	92.79	6.60	0.005
183.34-187.32	Cavity, infilled by unconsolidated red mud, calcareous, minor satin spar filled fractures 85° to core axis.					
187.32-190.15	Gypsum, white to grey, common interstitial calcareous grey silt. Contact erosional.	R-1100	187.55-187.83	85.77	9.18	0.044
		R-1101	188.98-189.26	32.16	54.37	0.024
190.15-192.94	Cavity infilled by red mottled grey mud, minor satin spar filled fractures 85° to core axis.					
192.94-197.03	Gypsum, white to grey, minor to common interstitial dolostone, vague laminae 45° to core axis.	R-1102	193.14-193.47	96.52	2.71	0.010
		R-1103	194.34-194.82	77.12	18.88	0.012
		R-1104	196.73-197.03	17.87	80.42	0.019



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
197.03-197.92	Mudstone, red mottled grey, poorly consolidated, minor satin spar filled fractures 90° to core axis.					
197.92-198.07	Gypsum, grey common interstitial dolostone.					
198.07-199.39	Mudstone, red mottled grey poorly consolidated, minor satin spar filled fractures 90° to core axis. Contact erosional.					
199.39-200.81	Gypsum, grey to orangish grey. Common interstitial grey dolostone, minor interlaminae 55° to core axis. Contact gradational.	R-1105	199.48-199.77	81.23	15.65	0.014
		R-1106	200.23-200.50	85.48	14.31	0.011
200.81-202.13	Limestone, light to dark grey in part, rubbly at top.					
202.13-202.90	Gypsum, white with interstitial orangish-grey limestone common. Contact erosional.	R-1107	202.31-202.64	87.25	6.3	0.009
202.90-203.05	Cavity, infilled by red calcareous mudstone, minor grey mottling, minor satin spar filled fractures 90° to core axis.					
203.05-205.31	Gypsum, greyish white, minor interstitial dolostone, cavities infilled by red mud common in lower part of unit.	R-1108	203.30-203.61	86.86	2.80	0.015
		R-1109	204.35-204.62	92.79	3.69	0.007
205.31-206.35	Cavity, infilled by red calcareous mudstone.					
206.35-208.18	Gypsum, white to light grey, minor to common interstitial mudstone, minor laminae 35° to core axis.	R-1110	206.52-206.86	90.93	3.67	0.017
		R-1111	207.26-207.57	94.32	2.43	0.006
208.18-208.36	Cavity, infilled by grey calcareous siltstone.					
208.36-208.79	Gypsum, light grey, minor interstitial grey mudstone few small cavities, increasing interstitial material towards base becomes poorly consolidated.	R-1112	208.48-208.69	92.88	4.31	0.015
208.79-219.81	Mudstone, shale, red mottled grey.					
219.81-220.50	Gypsum, as above.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
220.50-220.55	Cavity, infilled by grey calcareous mudstone.					
220.55-221.41	Gypsum, as above.	R-1113	220.88-221.18	75.40	18.05	0.006
221.41-221.51	Cavity, infilled by medium grey, poorly consolidated calcareous mudstone.					
221.51-221.97	Gypsum, white, common interstitial grey silt, two cavities in mid unit infilled by brownish-grey, calcareous siltstone. Contact erosional.					
221.97-225.17	Mudstone, shaly, reddish brown.					
225.17-239.27	Gypsum, greyish white, varying amounts of interstitial grey calcareous siltstone.	R-1114	225.55-225.88	96.37	0.62	0.013
		R-1115	227.25-227.51	34.45	55.68	0.032
		R-1116	228.73-229.98	88.49	9.78	0.017
		R-1117	230.26-230.48	95.94	3.88	0.011
		R-1118	231.65-231.93	99.81	0.19	0.006
		R-1119	233.17-233.42	94.70	1.67	0.005
		R-1120	234.70-235.03	97.90	2.09	0.006
		R-1121	236.22-236.55	92.84	2.65	0.006
239.27-240.33	Mudstone, light brown, slightly calcareous.	R-1122	237.67-237.90	95.08	2.37	0.023
		R-1123	238.48-238.81	26.52	1.59	0.005
240.33-246.28	Gypsum, light grey, minor interstitial calcareous grey siltstone.	R-1124	240.34-240.79	95.46	2.08	0.007
		R-1125	242.05-242.36	14.62	85.33	0.008
		R-1126	243.34-243.84	14.33	84.58	0.014
		R-1127	245.08-245.36	98.09	1.01	0.008
246.28-247.54	Cavity, infilled by grey mudstone, grades to red mudstone at base, minor stain spar filled fractures 30-90° to core axis.					
247.54-259.08	Gypsum, greyish white, saccharoidal texture, interlaminated with dark grey siltstone/mudstone, laminae ore 50° to core axis at top, 90° to core axis for 36 cm near top, then return to 50° below. Contact erosional.	R-1128	247.65-247.95	97.62	2.15	0.007
		R-1129	249.02-249.35	98.00	1.02	0.020
		R-1130	250.55-250.93	47.45	52.57	0.100
		R-1131	251.94-252.25	85.34	15.25	0.014
		R-1132	253.57-253.87	99.48	1.08	0.015
		R-1133	254.91-255.29	98.19	2.34	0.009
		R-1134	256.49-256.85	98.00	2.38	0.006
		R-1135	257.56-257.89	98.67	1.78	0.006
259.08-262.81	Mudstone, red poorly consolidated, calcareous, minor grey mottling. Contact gradational.	R-1136	258.80-259.08	99.48	0.15	0.006

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
262.81-266.09	Siltstone, greenish grey, noncalcareous, minor interlaminae of white limestone. Contact erosional.					
266.09-266.78	Gypsum, greyish white, minor interlaminae of dark grey siltstone/mudstone 45° to core axis. Contact erosional.	R-1137	266.22-266.50	99.77	0.64	0.010
266.78-267.36	Mudstone, medium grey, poorly consolidated, slightly calcareous minor satin spar filled fractures 35° to core axis.					
267.36-271.93	Gypsum, greyish white, minor interlaminae of dark grey mudstone/siltstone 50° to core axis. Contact erosional.	R-1138	267.54-267.84	99.10	1.17	0.007
		R-1139	269.04-269.34	98.24	1.20	0.012
		R-1140	270.76-271.14	63.21	2.84	0.008
271.93-277.90	Mudstone, red mottled grey, poorly consolidated, calcareous, gypsum filled fractures 65° to core axis. Contact erosional.					
277.90-278.76	Gypsum, greyish white, abundant interstitial dark grey dolostone in mid unit, slightly more pure at top and base.	R-1141	278.02-278.28	98.62	1.65	0.003
278.76-279.83	Dolostone, brownish grey, slightly calcareous, medium- to coarse-grained, grades to limestone, at base appears conglomeratic with limestone matrix. Contact erosional.					
279.83-280.09	Gypsum, greyish white, saccharoidal texture with minor interlaminae of calcareous grey mudstone 75° to core axis. Contact erosional.	R-1142	279.85-280.06	99.29	0.52	0.005
280.09-280.21	Cavity, infilled by grey and red calcareous mud. Contact erosional.					
280.21-280.42	Gypsum, as above.					
280.42-281.23	Cavity, infilled by red mottled grey calcareous mud. Contact erosional.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
281.23-285.50	Gypsum, light grey, minor to common interstitial dark grey mudstone/siltstone, minor selenite crystals near base. Contact erosional.	R-1143	281.35-281.71	97.28	1.14	0.008
		R-1144	282.88-283.18	91.26	1.48	0.006
		R-1145	284.17-284.61	97.23	2.33	0.007
		R-1146	285.06-285.39	96.61	2.35	0.004
285.50-289.74	Mudstone, reddish brown, poorly consolidated, calcareous. Contact erosional.					
289.74-301.29	Gypsum, greyish white, interstitial dark grey mudstone and greyish-brown limestone (at base), minor interlaminae 30-55° to core axis.	R-1147	290.17-290.52	86.91	1.63	0.018
		R-1148	291.64-292.00	98.00	0.54	0.006
		R-1149	293.12-293.50	22.55	74.50	0.031
		R-1150	295.05-295.43	34.07	60.56	0.078
		R-1151	296.82-297.23	95.42	2.65	0.006
		R-1152	298.40-298.80	94.60	2.82	0.007
		R-1153	299.77-300.15	91.69	2.62	0.007
		R-1154	300.84-301.12	88.06	1.13	0.013
301.29-307.09	Limestone, light grey to yellowish grey, calcareous, abundant gypsiferous horizons throughout.					
307.09-308.56	Gypsum, light grey to brownish white, varying amounts of interstitial grey dolostone.	R-1155	307.34-307.64	97.95	0.36	0.010
308.56-309.04	Cavity, infilled by light grey calcareous mudstone. Contact erosional.					
309.04-323.93	Gypsum, greyish white, minor interstitial light grey limestone, may be anhydrite in part.	R-1156	309.50-309.78	94.51	0.21	0.021
		R-1157	311.30-311.68	99.14	0.43	0.009
		R-1158	312.32-312.65	99.72	0.22	0.008
		R-1159	313.77-314.07	12.33	87.68	0.008
		R-1160	315.64-315.93	11.42	87.97	0.013
		R-1161	317.35-317.70	4.68	94.27	0.009
		R-1162	318.82-319.13	98.95	0.21	0.007
		R-1163	319.58-319.96	12.18	86.80	0.013
		R-1164	321.28-321.59	6.31	91.39	0.011
		R-1165	323.09-323.37	13.24	83.66	0.020
323.93-324.08	Cavity, infilled by dark grey impure gypsum.					
324.08-336.80	Anhydrite, greyish white, grades to gypsum in part, minor interstitial medium grey siltstone.	R-1166	324.51-324.84	13.81	83.10	0.010
		R-1167	325.43-325.76	18.06	78.84	0.023
		R-1168	327.07-327.46	13.95	82.75	0.008
		R-1169	328.37-328.70	24.70	72.24	0.018
		R-1170	329.87-330.20	21.02	76.22	0.029

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
336.50-344.55	Gypsum, greyish white, minor interstitial greenish-grey siltstone, minor interlaminae 60-70° to core axis. Contact erosional.	R-1171	337.08-337.41	98.52	0.23	0.008
		R-1172	338.73-339.07	98.57	0.71	0.005
		R-1173	339.95-340.18	97.14	0.22	0.007
		R-1174	341.58-341.89	96.95	0.74	0.008
		R-1175	342.92-343.23	99.53	0.67	0.010
		R-1176	344.22-344.50	88.78	9.33	0.010
344.55-345.54	Limestone, medium grey, well consolidated at top, rubbly below, laminae at top 60° to core axis. Contact erosional.					
345.54-346.08	Gypsum, white to light grey, minor to common interlaminated and interstitial medium grey dolostone.					
346.08-346.41	Dolostone, medium grey, grades to limestone at base of unit, brecciated.					
346.41-354.08	Gypsum, white to light grey, minor to common interstitial limestone/dolostone most abundant at top of unit, minor laminae 65° to core axis. Contact erosional.	R-1177	346.35-346.71	83.14	3.39	0.015
		R-1178	347.47-347.80	96.90	0.81	0.025
		R-1179	349.15-349.48	98.19	0.71	0.025
		R-1180	350.65-350.95	98.81	0.31	0.018
		R-1181	352.14-352.45	96.47	1.78	0.009
		R-1182	353.26-353.64	94.13	1.95	0.015
354.08-355.70	Cavity, infilled by reddish-brown, poorly consolidated mudstone, calcareous, satin spar filled fracture parallel to core axis. Contact erosional.					
355.70-360.63	Gypsum/anhydrite, greyish white, minor interstitial and interlaminae grey siltstone.	R-1183	357.78-358.06	49.02	46.54	0.079
360.63-361.21	Limestone, greenish grey, some gypsum remnants at top, massive below. Contact erosional.					
361.21-361.54	Siltstone, medium grey, gypsiferous. Contact erosional.					
361.54-362.18	Siltstone, dark greenish grey, to light grey, brecciated, calcareous.					
362.18-362.74	Gypsum, greyish white, minor interstitial silt and dark grey gypsum. Contact gradational.					
362.74-366.85	Anhydrite, light grey, massive, minor laminae at top 80° to core axis.	R-1184	362.92-363.02	29.19	70.01	0.013
		R-1185	364.41-364.77	8.79	90.75	0.011
		R-1186	365.76-366.06	11.71	86.40	0.015



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
366.85-373.71	Gypsum/anhydrite, grey, minor interstitial, greenish-grey siltstone, minor laminae 60° to core axis. Contact erosional.	R-1187	367.31-367.61	47.35	48.26	0.024
		R-1188	369.01-369.27	40.28	46.19	0.011
		R-1189	371.12-371.35	58.82	40.20	0.005
		R-1190	373.15-373.46	97.62	1.66	0.006
373.71-376.78	Siltstone, red mottled, light grey, calcareous, brecciated, minor gypsum filled fractures. Contact erosional.					
376.78-376.94	Gypsum, light grey, massive, minor interstitial material. Contact erosional.					
376.94-378.59	Limestone, greenish grey, minor gypsum. Contact erosional.					
378.59-379.38	Gypsum, greenish white, minor anhydrite.					
379.38-380.59	Cavity, infilled by mudstone/siltstone, greenish grey to red in colour, poorly consolidated, minor gypsum filled fractures and interbeds. Contact erosional.					
380.59-384.81	Gypsum/anhydrite intermixed, minor interstitial grey siltstone. Contact erosional.	R-1191	381.46-381.71	45.39	53.47	0.019
		R-1192	382.96-393.21	45.44	49.58	0.009
384.81-384.91	Cavity, infilled by greenish-grey siltstone, poorly consolidated. Contact erosional.					
384.91-385.24	Gypsum, greyish white to dark grey, minor interstitial siltstone. Contact erosional.	R-1193	385.01-385.24	99.86	0.41	0.005
385.24-386.26	Siltstone, light grey, calcareous, minor gypsum filled fractures. Contact erosional.					
386.26-386.46	Limestone, brownish grey, brecciated. Contact erosional.					
386.46-390.78	Anhydrite, light grey, minor interstitial brown siltstone.	R-1194	387.76-388.11	20.98	79.15	0.010
		R-1195	389.59-389.94	19.64	74.46	0.015
390.78-392.23	Limestone, light greenish grey, brecciated. Contact erosional.					
392.23-394.41	Siltstone/mudstone, light grey to reddish brown. Contact erosional.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
394.41-395.48	Gypsum, white to grey, minor interstitial grey silt.	R-1196	394.51-394.74	94.56	2.26	0.018
395.48-398.37	Limestone, medium to dark grey, massive, grades to siltstone at base.					
398.37-401.09	Gypsum/anhydrite, greyish white, minor interstitial grey siltstone. Contact erosional.	R-1197	400.25-400.58	32.68	67.40	0.013
401.09-401.52	Cavity, infilled by bluish-grey siltstone. Contact erosional.					
401.52-402.29	Gypsum, white to greyish white, minor interstitial dolostone, minor interlaminae 80° to core axis.	R-1198	401.78-402.11	98.38	1.02	0.007
402.29-403.56	Siltstone, light grey, brecciated. End of Hole.					

Drilling Performed By: St. Lambert Drilling

Geologist: R. L. Comeau

**NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY  
DIAMOND DRILL RECORD**

<b>Property:</b> Jubilee, Occurrence 0086 <b>Hole Number:</b> ATG-5-76 <b>Latitude:</b> 45°59'14" <b>Longitude:</b> 60°56'50" <b>Elevation:</b>	<b>Azimuth:</b> <b>Dip:</b> <b>Started:</b> <b>Completed:</b> <b>Ultimate Depth:</b> 114.91 m
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Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-20.42	Overburden.					
20.42-21.41	Gypsum/anhydrite, grey white, partially hydrated anhydrite, minor interstitial grey-brown limestone.	R-1280	20.78-21.11	56.76	41.90	0.007
21.41-26.37	Anhydrite, grey white, minor interstitial grey-brown limestone.	R-1281	23.87-24.21	4.78	93.06	0.011
26.37-49.94	Gypsum, white, minor interstitial grey dolostone. Contact unclear.	R-1282	26.92-27.23	98.28	1.02	0.005
		R-1283	30.10-30.46	97.76	0.47	0.049
		R-1284	32.99-33.32	96.80	0.88	0.005
		R-1285	35.94-36.32	99.24	0.65	0.005
		R-1286	38.86-39.14	98.05	1.06	0.005
		R-1287	43.41-43.76	97.76	1.04	0.007
		R-1288	45.97-46.31	99.34	0.86	0.005
		R-1289	49.12-49.43	97.09	0.70	0.004
49.94-52.38	Anhydrite, blue grey, increasing interstitial medium grey limestone, massive to nodular mosaic. Contact gradational.	R-1290	52.12-52.43	2.39	73.24	0.010
52.38-53.01	Limestone, medium grey, common interstitial anhydrite a top grades to massive limestone at base. Contact erosional.					
53.01-93.17	Anhydrite, blue white, minor to common interstitial limestone most abundant at top and base of unit.	R-1291	55.07-55.37	3.87	91.99	0.011
		R-1292	57.99-58.27	1.72	94.27	0.012
		R-1293	61.21-61.29	1.91	97.08	0.013
		R-1294	62.26-62.58	1.00	96.75	0.011
		R-1295	65.23-65.53	4.97	95.12	0.015
		R-1296	70.61-70.89	3.25	92.94	0.012
		R-1297	73.56-73.89	3.73	88.43	0.013
		R-1298	76.43-76.79	4.06	90.84	0.017
		R-1299	79.96-80.31	3.44	94.78	0.012
		R-1300	83.01-83.36	2.49	97.47	0.008
		R-1301	85.88-86.26	4.97	89.86	0.012
		R-1302	89.15-89.43	3.92	93.87	0.014
		R-1303	92.07-92.78	6.69	93.79	0.013

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
93.17-95.23	Anhydrite, grey, abundant interstitial limestone up to 50% in part.					
95.23-95.45	Limestone, orange brown, 20% anhydrite blebs.					
95.45-96.06	Limestone, grey green up to 10% anhydrite blebs.					
96.06-102.18	Anhydrite, white, nodular to nodular mosaic with over 10% interstitial grey limestone, minor selenite crystals, limestone most abundant at base. Contact gradational.	R-1304	96.16-96.47	3.63	91.26	0.010
		R-1305	98.25-98.55	4.21	94.49	0.012
		R-1306	98.88-99.16	3.30	95.28	0.008
		R-1307	100.91-101.24	7.31	75.77	0.011
102.18-102.44	Limestone, grey yellow, massive, minor gypsum filled fractures, laminated 60° to core axis.					
102.44-103.51	Gypsum/anhydrite/limestone intermixed, light grey.	R-1308	103.17-103.56	31.73	55.74	0.009
103.51-106.98	Limestone, grey, bedded and gypsiferous, beds dip 15-20° to core axis. Minor sulphides.					
106.98-109.58	Limestone, grey to dark grey, massive and bedded, fine grained, beds dip 5-15° to core axis, minor pellets, oolites and fossils, minor sulphides.					
109.58-114.91	Conglomerate, grey to red below, angular, unsorted, polymictic and calcareous.					
	End of Hole.					

Drilling Performed By: St. Lambert Drilling

Geologist: G. P. Isenor

Property: Jubilee, Occurrence 0086  
Hole Number: ATG-8-76  
Latitude: 45°59'06"  
Longitude: 60°57'14"  
Elevation:

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Azimuth:  
Dip:  
Started:  
Completed:  
Ultimate Depth: 127.10 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-15.24	Overburden.					
15.24-16.56	Gypsum, brownish white, saccharoidal texture, minor interstitial brownish-grey limestone.	R-1239	15.24-15.54	98.04	1.08	0.007
		R-1240	16.25-16.51	98.57	0.95	0.007
16.56-17.65	Anhydrite, contacts gradational, white, numerous gypsum filled fractures.					
17.65-19.58	Gypsum, white, saccharoidal texture, minor interstitial light grey limestone. Contact erosional.	R-1241	17.68-17.96	98.52	1.65	0.004
		R-1242	18.85-19.20	98.57	1.50	0.004
19.58-19.89	Anhydrite, grey white, abundant gypsum filled fractures.					
19.89-20.35	Anhydrite, medium grey, abundant interstitial very dark grey limestone. Contact gradational.					
20.35-20.57	Anhydrite, light blue, massive, minor gypsum along fractures at base of unit.	R-1243	20.42-20.78	10.03	76.11	0.007
20.57-21.82	Gypsum, white, minor interstitial light grey limestone.					
21.82-26.26	Anhydrite, blue grey to medium grey, variable gypsum along fractures and interstitial grey limestone, 5 cm interbed of grey-brown limestone at 25.37 m.	R-1244	22.10-22.38	14.76	82.70	0.007
		R-1245	23.87-24.18	3.30	93.58	0.011
		R-1246	25.76-26.08	3.82	95.73	0.009
26.26-26.49	Cavity or fracture in anhydrite filled in by dark grey limestone.					
26.49-36.02	Anhydrite, blue white, minor gypsum along fractures and interstitial grey-brown limestone. Texture nodular to nodular mosaic.	R-1247	27.71-28.02	3.82	96.70	0.006
		R-1248	29.06-29.39	12.76	83.88	0.011
		R-1249	30.99-31.29	2.49	93.75	0.008
		R-1250	32.46-32.79	2.63	96.34	0.010
		R-1251	33.83-34.14	2.63	82.62	0.014
36.02-36.22	Limestone, grey brownish, massive at top, common pyrite common anhydrite at base of unit. Contact gradational.					
36.22-36.80	Limestone/anhydrite, transition zone.					



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
36.80-53.75	Anhydrite, blue white to grey white, minor to common interstitial grey-brown limestone increasing to 30% at base of unit. Contact gradational.	R-1252	37.06-37.41	3.39	89.51	0.012
		R-1253	39.90-40.18	1.82	95.66	0.010
		R-1254	42.62-42.95	2.01	91.85	0.014
		R-1255	45.72-46.02	2.20	96.20	0.013
		R-1256	48.52-48.82	1.86	95.74	0.010
		R-1257	51.72-52.04	4.40	87.99	0.010
53.75-54.48	Limestone, grey brown, well laminated 55° to core axis, minor anhydrite filled fractures or blebs. Contact erosional.					
54.28-104.24	Anhydrite, light blue to bluish white, massive to nodular with minor to common interstitial grey-brown limestone.	R-1258	56.11-56.39	3.82	91.04	0.008
		R-1259	57.45-57.76	3.68	92.74	0.009
		R-1260	60.63-60.94	3.73	93.65	0.010
		R-1261	63.68-63.98	3.78	94.87	0.010
		R-1262	66.45-66.75	3.58	94.19	0.010
		R-1263	68.53-68.86	2.96	92.28	0.010
		R-1264	71.73-72.06	3.44	94.95	0.013
		R-1265	74.75-75.08	3.54	94.74	0.011
		R-1266	77.29-77.60	3.63	91.52	0.010
		R-1267	80.44-80.72	3.68	93.99	0.012
		R-1268	83.39-83.69	3.73	91.75	0.010
		R-1269	86.26-86.59	3.11	94.16	0.010
		R-1270	89.33-89.66	3.25	87.47	0.016
		R-1271	92.18-92.43	3.58	95.59	0.011
		R-1272	95.20-95.53	3.06	92.87	0.010
		R-1273	98.45-98.76	2.77	94.78	0.017
		R-1274	100.79-101.09	3.49	94.23	0.014
		R-1275	102.24-102.57	3.78	86.55	0.013
104.24-104.52	Limestone, grey brown, increasing percentage of anhydrite towards base of unit. Contact gradational.					
104.52-109.42	Anhydrite, light blue to blue grey, massive, variable interstitial grey-brown limestone minor gypsum at base. Contact gradational.	R-1276	104.52-104.80	3.68	77.52	0.012
		R-1277	105.42-106.27	7.36	62.09	0.019
		R-1278	107.01-107.37	3.87	94.65	0.009
		R-1279	109.07-109.37	4.21	89.90	0.009
109.42-109.58	Gypsum, grey white, hydration zone, increasing interstitial grey-brown limestone towards base. Contact gradational.					
109.58-114.86	Limestone, grey brown, common to abundant interstitial gypsum and/or anhydrite.					
114.86-117.71	Limestone, grey, massive, rubbly, poor recovery, minor sulphides.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
117.71-119.18	Limestone, grey, massive to bedded, algal, minor fossils, minor sulphides.					
119.18-121.16	Limestone, grey, massive algal micritic, vaguely laminated, minor sulphides.					
121.16-127.10	Conglomerate, grey, angular, well sorted, calcareous siltstone matrix.					
End of Hole.						

Drilling Performed By: St. Lambert Drilling

Geologist: G. P. Isenor

Property: Jubilee, Occurrence 0086  
 Hole Number: ATG-17-76  
 Latitude: 45°58'06"  
 Longitude: 60°56'59"  
 Elevation:

Azimuth:  
 Dip:  
 Started:  
 Completed:  
 Ultimate Depth: 89.31 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-3.96	Overburden.					
3.96-5.18	Anhydrite, white, hard, massive to nodular with minor interstitial, medium grey limestone.	R-1210	4.01-4.29	20.50	80.04	0.007
		R-1211	4.88-5.18	33.78	64.68	0.010
5.18-41.96	Anhydrite, blue grey, massive with <5% interstitial dolostone. Contact irregular.	R-1212	6.58-6.83	3.11	96.06	0.009
		R-1213	9.42-9.80	3.44	92.79	0.010
		R-1214	12.19-12.50	2.39	95.70	0.013
		R-1215	15.37-15.65	2.39	97.12	0.011
		R-1216	18.39-18.69	3.58	94.14	0.010
		R-1217	21.41-21.72	2.44	96.05	0.010
		R-1218	24.36-24.64	10.46	89.10	0.010
		R-1219	27.33-27.64	4.01	93.58	0.014
		R-1220	30.12-30.46	3.49	94.79	0.010
		R-1221	33.38-33.66	2.68	92.87	0.013
		R-1222	36.22-36.53	2.53	95.14	0.010
		R-1223	38.53-38.84	2.58	88.15	0.011
		R-1224	39.45-39.72	6.40	86.31	0.014
41.96-42.19	Cavity, infilled by secondary anhydrite with greasy texture. Contact erosional.	R-1225	41.96-42.21	2.49	98.02	0.009
42.19-44.40	Anhydrite, blue white, massive.	R-1226	42.57-42.82	2.92	97.33	0.009

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
44.40-52.88	Anhydrite, blue grey, minor to common interstitial limestone, massive to nodular.	R-1227	45.34-45.62	1.91	82.61	0.018
		R-1228	48.34-48.67	2.92	95.18	0.016
		R-1229	51.28-51.61	1.96	94.93	0.015
52.88-53.62	Limestone/anhydrite interlaminated to intermixed blue-grey anhydrite and medium grey limestone.					
53.62-53.82	Anhydrite, blue grey to blue white, massive.					
53.82-53.92	Limestone/anhydrite, as above.					
53.92-64.79	Anhydrite, white to light blue, minor to common interstitial limestone.	R-1230	54.23-53.64	1.96	77.81	0.017
		R-1231	57.28-57.53	1.86	91.44	0.012
		R-1232	60.30-60.58	2.39	85.85	0.015
		R-1233	63.17-63.50	3.01	68.63	0.020
64.79-64.82	Limestone, very dark grey, laminae 35° to core axis.					
64.82-65.00	Anhydrite, blue white, abundant orangish-grey dolostone interstitial.					
65.00-65.28	Anhydrite, blue white, minor interstitial dolostone increasing towards base. Contact gradational.	R-1234	65.00-65.33	4.30	95.59	0.005
65.28-67.01	Limestone, light grey, laminated 20° to core axis, increasing anhydrite content towards base of unit. Contact gradational.					
67.01-72.80	Anhydrite, blue white, massive, minor light grey interstitial limestone, minor selenite crystals.	R-1235	67.00-67.28	2.82	90.03	0.010
		R-1236	70.28-70.56	2.82	83.06	0.013
		R-1237	70.97-71.27	5.35	90.09	0.007
		R-1238	72.59-72.92	5.64	65.61	0.010
72.80-78.33	Limestone, grey, gypsiferous, vague bedding 10-15° to core axis, gypsum occurs as selenitic stringers.					
78.33-81.99	Limestone, dark grey, dense, micritic, white calcite stringers throughout.					
81.99-85.95	Limestone, black, organic rich, probably brecciated white calcite veins throughout.					
85.95-89.31	Conglomerate, grey, polymictic angular, pyritic.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
End of Hole.						

Drilling Performed By: St. Lambert Drilling

Geologist: G. P. Isenor

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Property:	Jubilee, Occurrence 0086	Azimuth:	
Hole Number:	ATG-71-79	Dip:	
Latitude:	45°58'56"	Started:	
Longitude:	60°56'01"	Completed:	
Elevation:		Ultimate Depth:	183.79 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-16.76	Overburden.					
16.76-162.76	Amax description: Anhydrite, blue grey, petroliferous, contains 2-5% carbonate throughout.					
162.76-167.54	Anhydrite, blue grey to dark grey, minor to common interstitial dolostone, nodular in part, minor selenite crystals.	R-1199 R-1200	162.76-163.04 164.44-164.74	2.39 2.68	88.26 92.49	0.010 0.006
167.54-167.94	Gypsum, grey, abundant interstitial limestone.					
167.94-168.10	Anhydrite, blue grey, massive, minor interstitial grey limestone.					
168.10-168.25	Gypsum, as above.					
168.25-168.99	Anhydrite, grey, common interstitial limestone, hydration along fractures.					
168.99-169.16	Cavity, infilled by poorly consolidated light grey calcareous mud. Contact erosional.					
169.16-169.60	Gypsum, white to grey, minor to common interstitial dark grey limestone (most abundant at top of unit)	R-1201 R-1202	168.20-168.51 169.22-169.57	10.08 92.69	69.15 0.86	0.010 0.007
169.60-170.10	Anhydrite, grey white with interlaminae of black limestone 90° to core axis, minor hydration along fractures.					

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
170.10-175.87	Limestone breccia, grey gypsiferous limestone breccia with pyrite, sphalerite and galena mineralization.					
175.87-179.22	Limestone, grey, laminated, massive, pyritiferous. Contact erosional.					
179.22-183.79	Conglomerate, grey green to reddish grey below pyritiferous and calcareous.					
	End of Hole.					

Drilling Performed By: St. Lambert Drilling

Geologist: G. P. Isenor

Property: Jubilee, Occurrence 0086  
Hole Number: ATG-72-79  
Latitude: 45°58'57"  
Longitude: 60°56'08"  
Elevation:

Azimuth:  
Dip:  
Started:  
Completed:  
Ultimate Depth: 180.75 m

Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
0-7.62	Overburden.					
7.62-60.96	Anhydrite, blue grey, massive, petroliferous, minor interstitial limestone.					
60.96-106.07	Anhydrite, blue grey to grey, increasing interstitial limestone with depth (become limestone with anhydrite at base); abrupt change back to anhydrite below.					
106.07-114.91	Anhydrite, blue grey, minor interstitial material.					
114.91-118.26	Anhydrite, grey, petroliferous, common interstitial limestone.					
118.26-121.01	Limestone, laminated and organic rich.					



Depth (m)	Formation	Sample Number	Sample Width (m)	Gypsum %	Anhydrite %	NaCl %
121.01-162.15	Anhydrite, blue grey, massive, variable amounts of interstitial limestone. (Isenor described as ?breccia of rounded anhydrite fragments in an anhydrite matrix.)	R-1203	153.19-153.49	3.01	90.46	0.007
		R-1204	154.33-154.61	3.30	82.62	0.010
		R-1205	155.42-155.78	3.39	53.26	0.023
		R-1206	156.97-157.25	2.49	85.96	0.013
		R-1207	158.67-159.03	3.63	90.05	0.008
		R-1208	160.48-160.78	3.68	86.67	0.006
		R-1209	161.57-161.85	6.31	63.57	0.008
162.76-167.18	Limestone, grey, brecciated pyrite, galena and sphalerite mineralization.					
167.18-171.30	Limestone/gypsum, interbedded grey laminated limestone and gypsum.					
171.30-173.74	Limestone, grey, laminated, massive basal limestone. Contact erosional.					
173.24-180.75	Conglomerate, grey green, pyritiferous.					
	End of Hole.					

Drilling Performed By: St. Lambert Drilling

Geologist: G. P. Isenor

**MAPS  
NOT  
FILMED**

**CARTES  
OMISES**